RADIOLOGY

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RADIOLOGY

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The Use of Delayed Films in Bronchography[1]

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San Francisco, Calif.

SINCE SICARD and Forestier first described a practical method of bronchography in 1922 (17), there have been relatively few refinements in the technic. The use of fluoroscopy and spot films, exposures in multiple projections, limitation of the amount of oil injected so as to avoid alveolar flooding, and postural drainage or suction of secretions from the discharging lung have all been recommended and incorporated into the bronchographic procedure. In spite of these advances, bronchograms are at times unsatisfactory. The limiting factors, no matter how exhaustive the effort, are (*a*) spread of the opaque material into the alveoli because of inability to control the cough reflex (an anesthetic failure) and (*b*) the incomplete opacification of some of the major or segmental bronchi for mechanical reasons. The first factor may be controlled by a careful and experienced topical anesthetist. The effect of the second factor may be partially eliminated by the use of films obtained one-half hour after the initial examination.

In the fall of 1948, we obtained a bronchogram on a 68-year-old man with a history of cough, productive of a moderate amount of sputum, for many years. The left upper and left lower lobes were nicely delineated, but the lingula was incompletely filled. We were thus unable to exclude lingular bronchiectasis. Because the roentgenograms were not of optimal technical quality, more films were obtained. During the interval of about forty-five minutes between the first and second examinations, no additional Lipiodol was administered. On the delayed films, much alveolarization of the medium had occurred and some had obviously been expectorated; *the lingular branches were now clearly visible*, however, and bronchiectasis could be excluded.

On the basis of this chance observation, an investigation of the value of delayed films in bronchography was initiated, and has continued until the present. The results of this investigation, embodied in an analysis of 100 consecutive bronchographic examinations performed between November 1948 and August 1951 in which delayed films were obtained, constitute the basis of this report.

In 1929, Jacobaeus, Selander, and Westermark reported attempts to evaluate the "expectoration time" of intrabronchial Lipiodol (9). As part of their investigation, they obtained serial exposures over a twenty-four-hour period in some cases, although they made no mention of these being of diagnostic value. Similarly, Sicard and Forestier obtained sequential

[1] From the Departments of Radiology, Stanford University School of Medicine, Stanford University Hospitals, and the San Francisco Hospital, San Francisco, Calif. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

TABLE I: EVALUATION OF DELAYED FILMS IN 100 CONSECUTIVE BRONCHOGRAPHIC EXAMINATIONS

Side of Bronchogram	Delayed Films of Value	Delayed Films of No Value
Right (61)	22	39
Left (39)	14	25
TOTAL (100)	36	64*

* Forty-two of these 64 had complete filling of all the lobes on the original films.

films over a period of months, in an effort to determine the time of disappearance of Lipiodol from the lung (17, 18). Fariñas utilized serial bronchography with spot films in some classical studies of the bronchial tree in pulmonary disease (5, 6). Di Rienzo employed a similar technic, using roentgenoscopic examination until the completion of the procedure, rather than delayed films obtained after a significant interval of activity and coughing (4). Others have used delayed films to show the disappearance of water-soluble media from the lungs (14, 15). As far as we know, the present report describes the first systematic effort to utilize delayed films, preceded by a period of coughing and activity, as a diagnostic adjunct in bronchography. A preliminary report has been presented elsewhere (1).

METHOD

One hundred consecutive bronchographic studies were performed on 75 patients. The technic used was as follows. After postural drainage, topical anesthesia to the larynx and tracheobronchial tree was administered by the radiologist in the examining room of the Department of Radiology. A rubber catheter was then passed into the trachea and the patient was transferred to the fluoroscopic room. There, under fluoroscopic control, the bronchial tree was delineated with Lipiodol and spot films were taken as indicated. Suitable manipulation was used to fill all possible branches, and the procedure was completed as quickly as possible. The time and manipulation necessary for bilateral bronchograms frequently resulted in reappearance of the cough reflex and a poor study and, in addition, precluded the effective use of a lateral film. Hence, Lipiodol examination was limited to one side during each study. Ten cubic centimeters was usually the maximum volume of Lipiodol used. Immediately after adequate filling was obtained, upright postero-anterior, oblique, and lateral films were taken. The patient was then permitted to sit or stand and was informed that he could cough or talk at will. Early in the study, delayed films were taken within one hour after the original films, but experience with different time intervals indicated that films at one-half hour after the first exposure yielded adequate information. On some patients, multiple sets of delayed films, extending over a period of twenty-four hours, were obtained, although only the first set was used for purposes of analysis.

In evaluating the material, the initial films were first studied separately and their adequacy for each lobe and segment was tabulated. The presence of bronchial disease, either suspected or definite, was also recorded. The delayed films were then compared with the originals, and the changes which had occurred in the distribution of the opaque material was designated in one or more of a number of categories: *e.g.*, alveolarization; bronchi less well visualized, equally well visualized, or better visualized; bronchiectasis still visible, now demonstrated, better shown, etc. Finally, on the basis of this analysis, the bronchogram was placed in a "value bracket" (bronchiectasis established, bronchiectasis excluded, or better visualization), or in a "no value bracket" (original satisfactory or original unsatisfactory). Satisfactory filling of the bronchial tree implied the demonstration of not only the major bronchi but also the segmental branches of all lobes. Failure of opacification of any one segment, despite an otherwise complete study, was recorded as an unsatisfactory bronchogram.

RESULTS

In 36 of 100 consecutive bronchograms, delayed films proved of value (Table I). In 10 cases, delayed films established the

TABLE II: CONTRIBUTION OF DELAYED FILMS IN INDIVIDUAL CASES

Value	Number of Cases
Bronchiectasis established	10
Bronchiectasis excluded	13
Bronchi better visualized	13

was established, and in one there was better visualization of the bronchial tree. On the whole, delayed films of the upper lobes cannot be expected to be of much value with our present technic.

TABLE III: VALUE OF DELAYED FILMS: ANALYSIS BY LOBES*

Value	Right Upper	Right Middle	Right Lower	Left Upper	Lingula	Left Lower
Bronchiectasis established	1	7	4	—	1	3
Bronchiectasis excluded	—	3	6	—	3	4
Bronchi better visualized	1	5	3	—	3	4

* Note that the total is greater than 36 because the delayed films were occasionally of value in more than one lobe in a single bronchogram.

presence of bronchiectasis not demonstrated in the original examination. In 13 cases, bronchiectasis was excluded when the original examination suggested that it might be present. In an additional 13 cases, branches which were not previously seen were delineated and the normalcy of doubtful portions of the bronchial tree was established (Table II). The sites of primary utility were the lower lobes, the middle lobe, and the lingula. This is well seen from the breakdown of "value" cases according to specific lobes (Table III).

In 64 cases, delayed films were of no value. In 42 of these, there was complete filling of all lobes, and delayed films were superfluous by our present criteria; they were obtained as part of the study in an effort to be inclusive and to exclude selection as a factor influencing the apparent value of this technic. In about one-third of the "no value" cases, the silhouette of the lower lobe, middle lobe, and lingular bronchial tree was as well shown as on the original. In a small number of cases, the branches were more clearly visualized. This was not true of the upper lobes, in which alveolarization and clearing of the bronchial tree of Lipiodol were the rule. On the whole, in the majority of "no value" cases, a large quantity of the opaque material had been expectorated, and there was a significant amount of alveolar filling.

Upper Lobes: Delayed films were of no value in the study of the left upper lobe, and in only 2 cases were they of value in the right upper lobe. In one of these, bronchiectasis

Right Middle Lobe: Delayed films were of particular value in clarifying the status of the right middle lobe bronchi. In 7 instances, the presence of bronchiectasis was established. In 3 cases, suspected bronchiectasis was excluded, and in 5 cases there was better visualization of the bronchial tree, confirming its normalcy. The patient whose films are shown in Figure 1 was a 68-year-old woman with multiple hospital entries since 1942, usually with a diagnosis of bronchitis. She was readmitted in 1950 with a history of productive cough of many years duration, yearly attacks of malaise and fatigue, and multiple upper respiratory infections. Physical examination was essentially negative. A bronchogram was obtained, with good opacification of both the upper and lower lobe bronchi but poor filling of the middle lobe bronchi. On the delayed film, there was evidence both of partial atelectasis and marked saccular bronchiectasis. A right middle lobe resection was performed, with confirmation of the bronchographic findings.

The roentgenograms of an 80-year-old woman with chronic cough, productive of a large amount of sputum, are shown in Figure 2. Bronchiectasis was strongly suspected clinically. On the original films, all but the middle lobe segments were visualized and appeared normal. The delayed films permitted a positive statement that the middle lobe branches were also normal.

Right Lower Lobe: In 4 cases, bronchiectasis in the right lower lobe was estab-

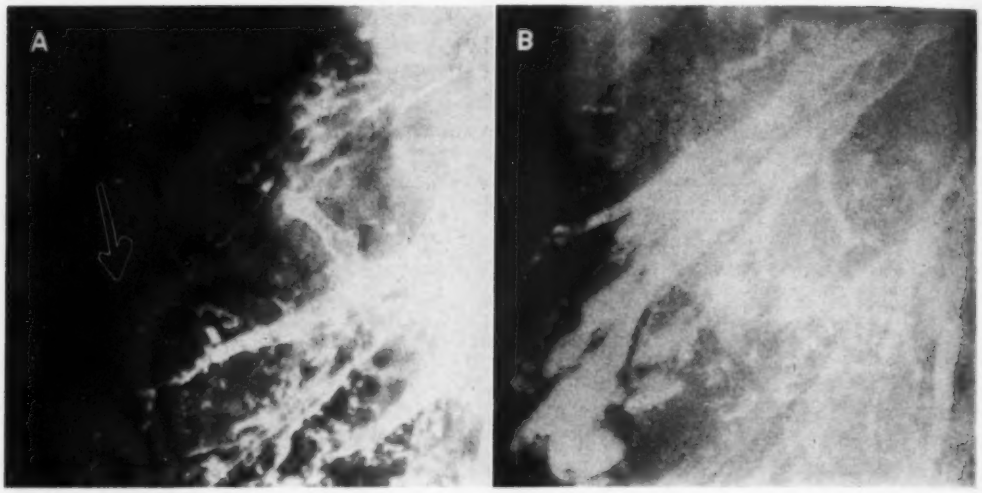

Fig. 1. Case I. Right middle lobe, bronchiectasis established. A. Left anterior oblique, original. B. Left anterior oblique, delayed.

On the original films, the right middle lobe branches failed to fill. The delayed films demonstrated marked bronchiectasis with partial collapse as evidenced by the clumping of branches. Findings confirmed at surgery.

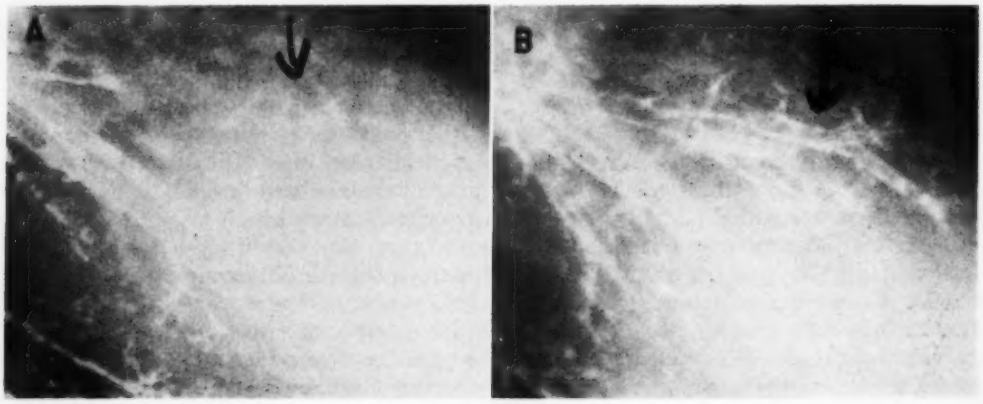

Fig. 2. Case II. Right middle lobe, better visualization. A. Right lateral, original. B. Right lateral, delayed.

In the original study, all segments of the right lung with the exception of the lateral segment of the middle lobe were adequately seen. The delayed film demonstrated satisfactory filling of this segment. The patient was an 80-year-old female with a history of several months of cough and expectoration.

lished, and in 6 cases excluded. In 3 additional cases, there was better visualization of the bronchial tree. Figures 3 and 4 illustrate the efficacy of delayed films in excluding bronchiectasis suspected on the original examination. In both of these cases, a repeat bronchogram would have been necessary had delayed films not been obtained. The history in Case IV was one of recurrent attacks of bronchitis, cough, and expectoration of thick yellow sputum for many years. Following bronchoscopy, purulent secretion was reported coming from the right lower lobe bronchi. Bronchography ruled out the presence of bronchiectasis.

Lingula of the Left Upper Lobe: The presence of bronchiectasis in the lingula of the left upper lobe was established in 1 and excluded in 3 cases on the delayed films.

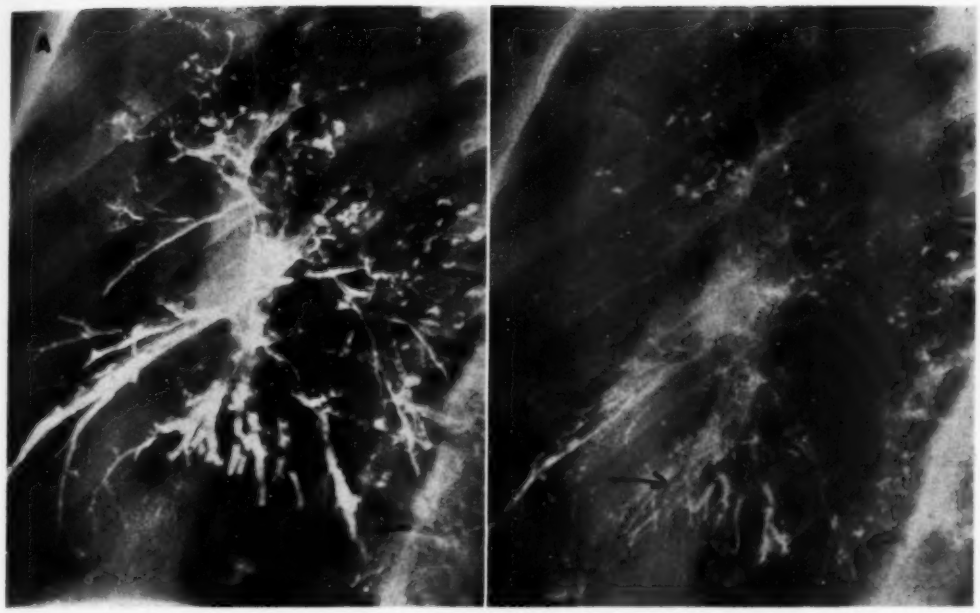

Fig. 3. Case III. Right lower lobe, bronchiectasis excluded. A. Left anterior oblique, original. B. Left anterior oblique, delayed.

On the original films, the opaque material failed to flow into the distal portions of the lower lobe bronchi. The possibility of bronchiectasis was suspected. Delayed films demonstrated normal tapering and caliber of the basal branches. The patient was a 50-year-old male with a four-year history of cough, expectoration, and exertional dyspnea.

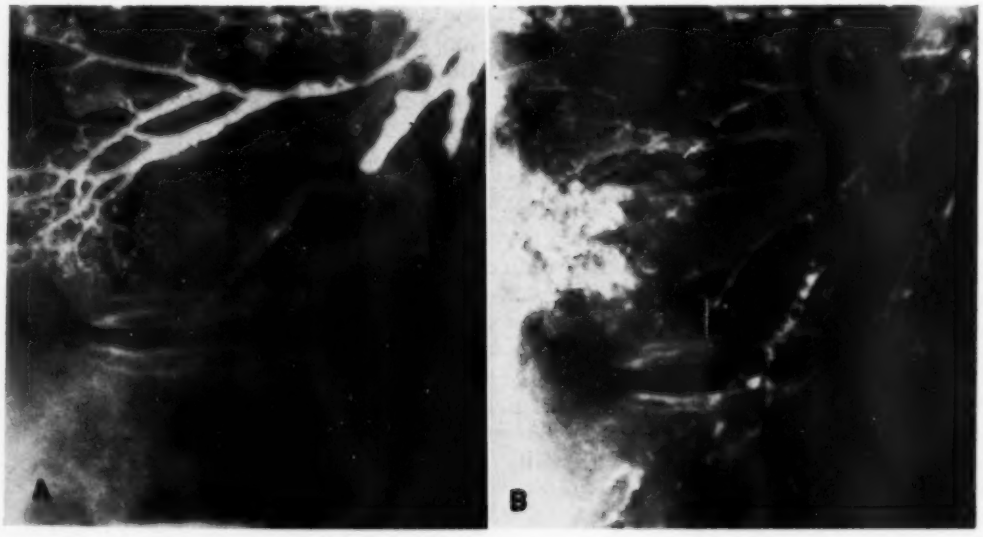

Fig. 4. Case IV. Right lower lobe, bronchiectasis excluded. A. Right lateral, original. B. Right lateral, delayed.

Some of the posterior basal segments failed to fill on the original studies. The irregularity of outline of the proximal portions of these bronchi was considered suspicious of bronchiectasis. Delayed films showed normally tapering posterior basal branches. The patient was a 46-year-old female with a history of many years of chronic cough with expectoration of thick yellow sputum, occasionaly tinged with blood.

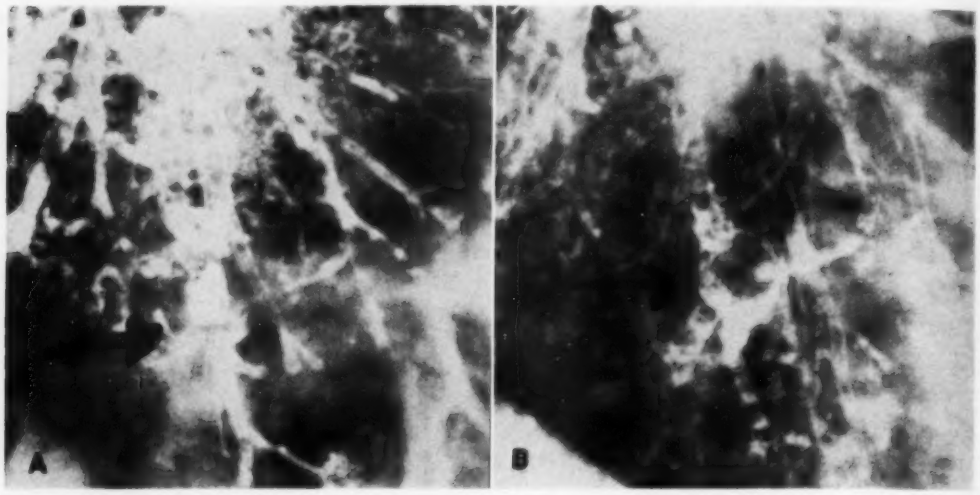

Fig. 5. Case V. Left lower lobe, bronchiectasis established. A. Left lateral, original. B. Left lateral, delayed.

The original examination showed a somewhat broadened caliber of a middle basal bronchus, suggestive of bronchiectasis. Delayed films demonstrated a large bronchiectatic sac in the lower lobe. The patient was a 27-year-old female with an eight-month history of cough, expectoration, and recurrent bouts of pneumonia.

Significantly better demonstration was obtained in 3 cases.

Left Lower Lobe: In 3 cases bronchiectasis of the left lower lobe was demonstrated on the delayed films, and in 4 cases it was excluded. There was improved visualization of the left lower lobe branches in 4 instances. The original film in Case V (Fig. 5) showed a somewhat broadened caliber of the middle basal branches. On the delayed films, it was apparent that there was a larger bronchiectatic sac at this site.

The patient whose films are shown in Figure 6 had a five-year history of chronic cough, gradually increasing in severity and productive of one to two cups of mucopurulent sputum daily. Although the original films were suggestive of bronchiectasis, the degree of involvement demonstrated on the delayed films was far greater than had been suspected.

DISCUSSION

Bronchography is not an innocuous procedure. Both the topical anesthesia (20) and the iodized oil may produce undesirable sequelae (2, 7, 10, 12, 19, 21). It is apparent, then, that repeated investigations constitute an unnecessary hazard, and that every effort must be made to obtain sufficient information from the initial examination. Fluoroscopy during bronchial filling helps to accomplish this. Limiting the amount of oil used decreases the likelihood of alveolar flooding (3). But over and above all possible precautions, there remains a group of cases in which adequate filling of all branch bronchi cannot be accomplished initially. Spasm of the truncular sphincter is probably one explanation; another and more common one is that retained secretions in the bronchiectatic sac block the flow of the medium. Efforts to aspirate the viscid bronchial secretions from the discharging lung prior to bronchography have occasionally been successful (11); as a routine procedure, however, extensive bronchial aspiration is impractical. Delayed films have proved useful in overcoming the failure of adequate filling, although they should not be used as a substitute for careful, exhaustive efforts to produce complete bronchial opacification initially.

The indications for delayed films are

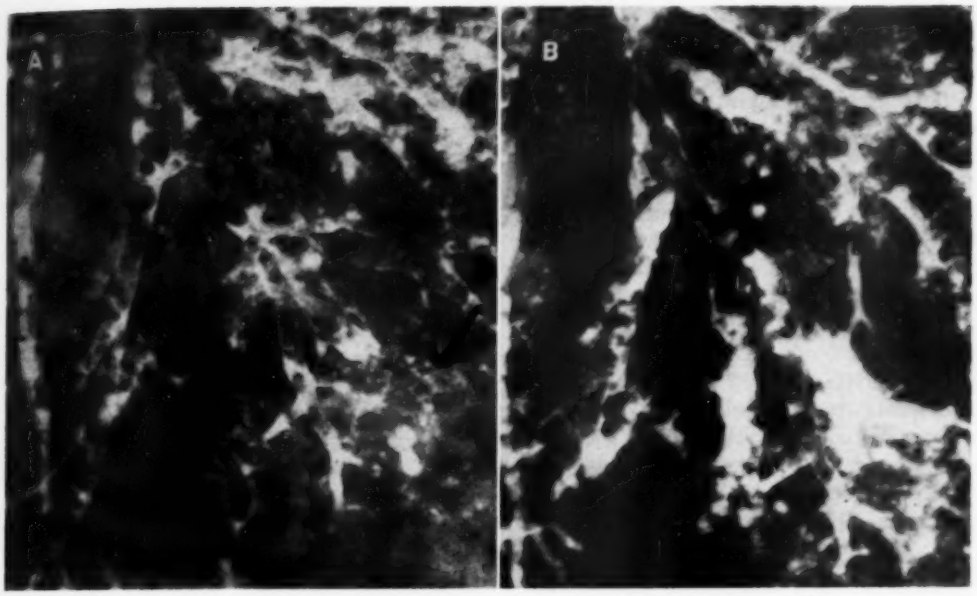

Fig. 6. Case VI. Left lower lobe, bronchiectasis established. A. Left lateral, original. B. Left lateral, delayed.

Bronchiectasis was suggested by pooling of Lipiodol in the original studies. Delayed films demonstrated extensive bronchiectatic change in the left lower lobe. The patient was a 52-year-old male with a five-year history of cough, gradually increasing in severity and productive of one to two cups of purulent sputum daily.

clear-cut; they should be obtained whenever the bronchi to the lower or middle lobes are inadequately demonstrated. They are of no value when all arborizations of the bronchial tree have been clearly delineated. In such instances, slightly better visualization may occasionally be obtained, but the information provided is insufficient to justify the additional films.

The mechanism rendering delayed films of value is of interest. In the patient in whom bronchiectasis is demonstrated on the delayed films, at least two elements are operative. One of these is the force of gravity. With the patient in the upright position over a period of thirty minutes, the opaque oil descends to the more caudad portions of the lungs, mixes with the retained secretions in bronchiectatic sacs, and at length outlines the segment of the involved bronchus. A second and perhaps equally important factor involves the dynamics of cough. Di Rienzo has pointed out that in the act of coughing, the movement of secretions and air is accomplished by a "peristaltic expulsive wave" (4). The caliber of the bronchus narrows considerably in a continuous process, beginning with the smaller branches and then involving the larger trunks. Because of the destruction and fibrosis of the wall of an ectatic portion of a bronchus, it cannot participate in this process. With the contraction of the bronchial wall immediately proximal to the bronchiectatic segment, the opaque material is compressed and may be forced in both directions, *i.e.*, both proximally to the larger branches, and distally to the fixed, dilated portion of the bronchus, which it then outlines.

In the demonstration of normal branches not visualized on the original films, the most important element is the gravitation of the Lipiodol to the dependent portions of the bronchial tree. In addition, relaxation of the truncular sphincter previously in spasm may well explain the filling of normal branch bronchi in some instances, especially in asthmatics or patients with chronic bronchitis.

A method of using delayed films to gain additional information about the upper lobes is under investigation. This consists of placing the patient in the Trendelenburg position for a half-hour after the completion of the initial procedure and then obtaining delayed films. In this way, gravity might be utilized for better demonstration of segments of the upper lobe bronchial tree, particularly in the exploration of tuberculous bronchial disease.

SUMMARY

1. In 100 consecutive bronchographic examinations performed on 75 patients, delayed films were obtained from thirty to sixty minutes after the initial films. During the interval, coughing and other normal activity were permitted.

2. In 36 of 100 examinations, delayed films were of definite value. Bronchiectasis was established by the delayed films in 10 cases, although the original study had failed to demonstrate it. In 13 cases, bronchiectasis suggested on the initial films was excluded, and in an additional 13 cases bronchi were demonstrated which had not been filled originally.

3. Delayed films were of primary value in the exploration of the middle lobe, the lower lobes, and the lingula.

4. The indications for delayed films are discussed and the mechanisms rendering them of value are suggested.

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ADDENDUM: After this article was completed, the following reference was called to our attention:

KANE, I. J., AND HEISER, S.: Indications for a Delayed Roentgenogram in Bronchography. J. Thoracic Surg. **24:** 70–74, July 1952. The authors include three illustrations of the usefulness of delayed films.

SUMARIO

El Empleo de Radiografías Retardadas en la Broncografia

En 100 exámenes broncográficos consecutivos, ejecutados en 75 enfermos, obtuviéronse radiografías retardadas de treinta a sesenta minutos después de las iniciales. En los intervalos, se permitió toser y además realizar otros actos normales. En 36 de los 100 exámenes, las películas retardadas resultaron de valor bien definido. En 10 casos, se estableció con las radiografías retardadas la existencia de bronquiectasia, aunque no la había revelado el estudio primitivo. En 13 casos, se excluyó la bronquiectasia indicada por las radiografías iniciales, y en otros 13, se pusieron de manifiesto bronquios sin llenar la primera vez.

Las radiografías alcanzaron su valor principal en la exploración del lóbulo medio, de los lóbulos inferiores y de la língula. Las indicaciones para su uso son bien definidas. Deben tomarse siempre que en el estudio primitivo no se pongan de manifiesto adecuadamente los lóbulos medio o inferiores, careciendo de utilidad cuando se han demarcado satisfactoriamente todas las arborizaciones bronquiales.

Discútese el mecanismo que dota de valor a las radiografías demoradas. Un factor importante es la gravitación del medio de contraste a las porciones bajas del árbol bronquial cuando el enfermo está erguido. Puede también desempeñar su papel la relajación del esfínter del tronco, que se hallaba antes en espasmo.

DISCUSSION

Gilbert W. Heublein, M.D. (Hartford, Conn.): Success in bronchography with iodized oil depends upon adequate preparation of the patient, proper choice and application of the anesthetic agent, and careful positioning of the patient under fluoroscopic control to secure complete mapping of the bronchial tree. Every effort should be made to outline all the necessary bronchopulmonary segments or sublobar components of both lungs by appropriate films and by whatever means.

A bronchogram, to be adequate, must supply precise information upon which the surgeon can rely for guidance in resection of one or more diseased bronchopulmonary segments and at the same time allow him to conserve as much normal lung as possible. This concept first evolved from the fundamental work of Churchill, in 1939, who stated that failure to visualize all portions of the bronchial tree is a certain step to an unsatisfactory postoperative result and an operative failure. Any method then, which will achieve the goal of complete bronchial visualization, is worthy of consideration. If the accuracy of roentgen diagnosis can be materially improved in one out of three hospital bronchograms, as has just been shown, by the simple maneuver of securing delayed films, then the use of delayed films in selected cases will be of inestimable value.

Another approach to this problem of better bronchial filling is to employ an anesthetic agent to which a small amount of epinephrine has been added. Barbour and Godfrey, working at the Hartford Hospital, have shown that bronchial exploration with iodized oil is facilitated by a topical anesthetic containing a solution of epinephrine hydrochloride in weak concentration. This, of course, enhances bronchial dilation and allows maximal filling of the pulmonary segments under investigation. It has been found that the use of 1 per cent Pontocaine hydrochloride to which has been added 5 drops of epinephrine hydrochloride (1:1,000) per hundred c.c. has a most salutary effect; ventilation is improved to such an extent that the sensation of smothering is overcome and the entire radiographic procedure is facilitated. Bronchography actually becomes a pleasure!

The vasoconstriction induced permits more prolonged anesthesia with smaller amounts of the drug, which is to be desired. With bronchial relaxation, the secondary and tertiary bronchi and their peripheral branches fill relatively promptly, so that rapid flash-film work is essential in order to show the initial stages of filling. Intermediate and delayed films can then be secured as indicated. In the mild asthmatic, for whom bronchography, for one reason or another, becomes necessary, administration of this combination of drugs offers prophylactic protection against the onset of bronchoconstriction and the chances of precipitating an attack of asthma are reduced.

Another method by which more complete filling can be achieved, recently called to our attention

by Dr. Roy Greening of the University of Pennsylvania Hospital X-ray Department, is similar to that described by Dr. Abrams. Dr. Greening states, "As to delayed bronchography, we have used this sparingly. Recently, when we have found segments which we could not outline in fifteen or twenty minutes, we have had the patient cough a few times after preliminary films and then made more films. This accomplishes a situation similar to a longer delayed period. On several occasions, as with the longer delay, we have been able to demonstrate small bronchiectatic areas and areas drained by small scarred bronchi." It is the impression of the University of Pennsylvania group, then, that delayed bronchography has not been employed to its utmost.

Delayed films are advantageous from a purely technical standpoint. In the first part of our examination with the adrenalin technic, as just pointed out, first and second order bronchi and their branches fill rapidly, so that the use of a quick change-over spot-film device with the Morgan-Hodges phototimer is helpful. After the patient is positioned in the manner described by Gilfillan, Davenport, Vickers, and others, the intermediate phases of bronchial filling are recorded by a Bucky-film, horizontal, high-kilovoltage technic at 40-inch distance. Subsequently, where filling has been impeded by truncal spasm or air or hydrostatic block, we order non-Bucky, erect 6-foot roentgenograms. These late films not only ensure a complete study, but also record the final phases of bronchial filling and alveolar dispersion. Distortion is avoided and false positive diagnoses of "minimal cylindrical ectasia" are thus more readily eliminated. By exploiting this simple means or some variation of it, it is our impression at Hartford that the final picture of the abnormal bronchopulmonary segment will ultimately be elucidated.

Dr. Abrams (*closing*): I would like to thank Dr. Heublein for his discussion. We have been using epinephrine as part of our topical anesthesia for bronchography for many years. All of the pre-bronchography anesthesia is done in the Department of Radiology by one of the resident radiologists, who becomes very proficient after a time. I think this is a very important point, since effective anesthesia is a prerequisite of good bronchography.

In addition, I should stress the point that we obtain numerous spot films during fluoroscopy, but that delayed films are reserved for those instances in which both the spot films and the initial upright films fail to delineate satisfactorily all of the segmental branches of the bronchial tree.

Pulmonary Manifestations of Leptospirosis[1]

CHARLES M. SILVERSTEIN, M.D.
Atlanta, Ga.

FOR A LONG TIME leptospiral infections have been relatively neglected by the medical profession of this country. During the past decade, however, their prevalence, protean manifestations, and importance as a public health problem have received ever-increasing attention.

"Leptospirosis" is the disease produced by any of the group of spirochetes known as *Leptospirae*. There have been about 30 pathologic strains of these organisms identified throughout the world, but only four (*L. icterohaemorrhagiae*, *L. canicola*, *L. pomona*, and *L. grippotyphosa*) have thus far been recognized in the United States.

Both in this country and abroad *L. icterohaemorrhagiae* produces the most distinctive, common, and virulent type of leptospiral infection, the acute febrile illness known as "Weil's disease." It should be pointed out that there has been considerable inconsistency in the use of this eponym in the medical literature. Weil (24) in 1886 originally described four cases characterized by chills and fever, cerebral and urinary symptoms, jaundice, hemorrhagic diathesis, and an enlarged spleen, and distinguished these from typhoid fever. At that time, the spirochetal etiology was not suspected, nor did Weil associate the disease with the presence of rats or other vectors. Some writers, nevertheless, including Ashe (1), Bertucci (5), and Sacks (15), have assumed that Weil's name should be reserved for the infection produced by the *icterohaemorrhagiae* strain (as it is employed in this paper). Beeson (3, 4) and others have used the term "Weil's disease" to designate a clinical syndrome including all the icteric forms of leptospirosis, by whatever strain they may have been produced. Still other writers have made "Weil's disease" synonymous with "leptospirosis."

In the typical case, Weil's disease is characterized by fever, muscle pains, conjunctivitis, leukocytosis, a variable hemorrhagic tendency, and by signs of acute hepatitis, and nephritis. It is transmitted chiefly by infected rats and is an occupational hazard for those who work in damp places likely to be infested with these rodents.

The clinical picture caused by *L. icterohaemorrhagiae* may, however, be quite atypical. The manifestations may be mild. Jaundice is absent in 30 to 40 per cent of the cases, and meningeal, renal, or other organ involvement may produce the most important clinical feature. In its first or septicemic stage, this illness may be indistinguishable from other acute infectious diseases.

L. canicola, carried only by dogs, produces the picture of "typical Weil's disease" in about 10 per cent of cases. In *canicola* fever the illness tends to be less severe, jaundice is usually absent, and an aseptic meningitis is a relatively more prominent clinical feature. Cargill and Beeson (7) have emphasized that most patients with *L. icterohaemorrhagiae* and *L. canicola* infections have a spinal fluid pleocytosis, even in the absence of symptoms.

In 1952 the first known case of infection with *L. grippotyphosa* in the United States was reported (18). The patient was an elderly farmer, and the main clinical finding was severe hepatitis, with jaundice, fever, and edema. The diagnosis was made by serum agglutination studies. In Europe, where it is known as "mud fever," "swamp fever," or "field fever," the syndrome produced by this strain is usually

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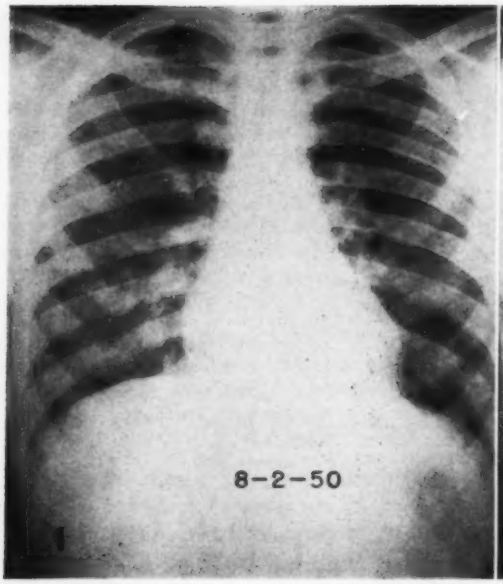
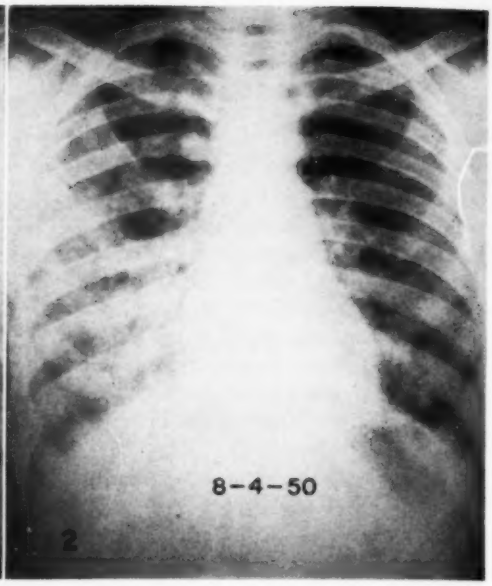
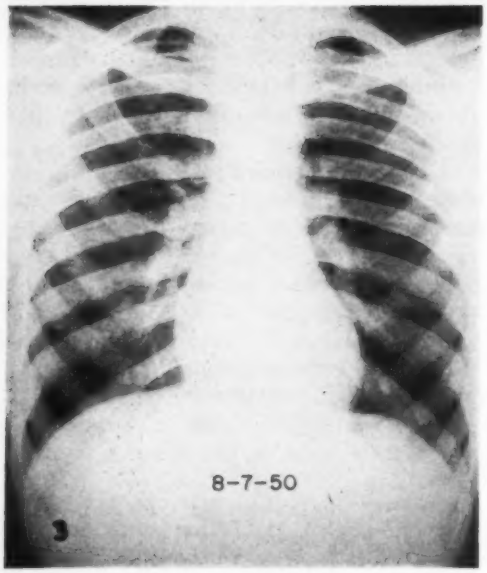






Figs. 1–3. Case I.
Fig. 1. Acute disseminated small pulmonary lesions.
Fig. 2. Roentgenogram made two days later, showing infiltrations increased in number, becoming confluent in right lower chest.
Fig. 3. Three days later the lung fields have cleared.

described as a mild attack of Weil's disease without jaundice (6). The animal reservoir is a variety of rodents, chiefly the field vole.

L. pomona infections are still rare in this country. Hogs and cattle are the chief animal hosts for this organism, which usually produces a syndrome of aseptic meningitis with mild systemic symptoms. The association of this illness with pig tenders has resulted in the name "swineherd's disease."

The pulmonary changes in leptospirosis are usually only incidental findings, representing part of the widespread involvement by this disease. Occasionally, however, a hemorrhagic pneumonitis may be an early or predominant clinical manifestation and present a bizarre diagnostic problem. For this reason, the following 3 cases are believed worthy of reporting.

CASE I: W. L., a 20-year-old colored meat packer, was admitted to Grady Memorial Hospital on Aug. 3, 1950, two weeks after having been bitten by a rat, on the heel and back of the hand. He complained of chest pain, cough, and sore neck. Five nights before admission, he had noticed the fairly sudden onset of frontal headache, malaise, and alternate chilly sensations and flushing. The following day his headache subsided but his neck was somewhat sore and stiff and his back began to ache. Three days before admission he continued to do a full day's work, but noticed that his eyes were somewhat yellow and that his urine appeared darker than usual. Two days before admission he felt too sick

to work, and stayed in bed. On this day he experienced cramping, burning mid-epigastric pain. The following day bilateral pleuritic anterior chest pain occurred, with a persistent cough productive of white mucoid sputum streaked with blood. Backache, malaise, and chilly sensations continued. At the Emergency Clinic a chest roentgenogram showed numerous small pulmonary infiltrations which were uniformly disseminated, with no tendency to confluence (Fig. 1). Most of the lesions appeared to be 3 or 4 mm. in diameter, the largest measuring approximately 6 mm. They were usually not sharply defined, although some had a nodular appearance.

The patient did not appear ill. Physical examination showed slight conjunctivitis but no evidence of icterus, questionable stiffness of the neck but no muscle tenderness there or elsewhere. Respirations were mildly labored. Breath sounds were diminished throughout the chest, with scattered crackling râles. The sputum was grossly bloody. The temperature was 101°.

Urinary findings were repeatedly normal. The red blood cell count was 3,600,000, with 12.4 gm. hemoglobin. The white cell count was 8,850, with 73 per cent segmented forms. Platelets were adequate. The icterus index was 12 units. Serum bilirubin on two occasions was 0.4 mg. per cent. Non-protein nitrogen was 35 mg. per cent, cephalin flocculation (Aug. 7) 4 plus, thymol turbidity 3 units, bromsulfalein retention 8 per cent after forty-five minutes. The sputum (Aug. 3) was thin, mucoid, and bloody, with some gram-positive rods and chains. Multiple sputum and blood cultures were negative. Bleeding and clotting times were normal. The electrocardiogram was normal.

Treatment and Hospital Course: Intramuscular administration of Penicillin was begun at once, 5,000 units every three hours. On the first night the temperature rose to 104° and respirations to 40 per minute. By the morning of Aug. 4 the patient appeared extremely ill and dyspneic, and the sputum thickened and became more grossly bloody. On physical examination chest findings were suggestive of consolidation in the region of the right middle and lower lobes. A chest roentgenogram (Fig. 2) showed a considerable increase in the small disseminated pulmonary infiltrations, which became somewhat confluent in the right lower chest. The white blood cell count rose to 16,850. Spinal fluid examination revealed 45 white blood cells, with 26 per cent polymorphonuclear leukocytes. Aureomycin was added to the therapy. That night the temperature dropped to 100°.

On Aug. 5 the patient appeared in critical condition. In addition to marked respiratory distress and increasing bloody sputum, there were severe headache, signs of meningeal irritation, and stupor. The spinal fluid now had a ground-glass appearance, with 880 white blood cells, 92 per cent polymorphonuclear leukocytes, and 127 mg. per cent of protein. In the afternoon the temperature rose to 103°, and Streptomycin was added to the medication, Penicillin being discontinued.

By the following day there was a remarkable recovery. The patient looked and felt well. The hemoptysis had ceased, and there was now only a slight cough. The neck was only slightly stiff. The temperature was normal and remained so thereafter. On this day the spinal fluid examination showed 960 white blood cells, with 50 per cent polymorphonuclears. On subsequent examinations the white blood cells in the spinal fluid progressively diminished.

On Aug. 7, two days after the fastigium, a chest roentgenogram (Fig. 3) showed the lung fields to be perfectly clear. The Streptomycin was discontinued; Aureomycin was continued until Aug. 11. The patient remained asymptomatic and was discharged on Aug. 14.

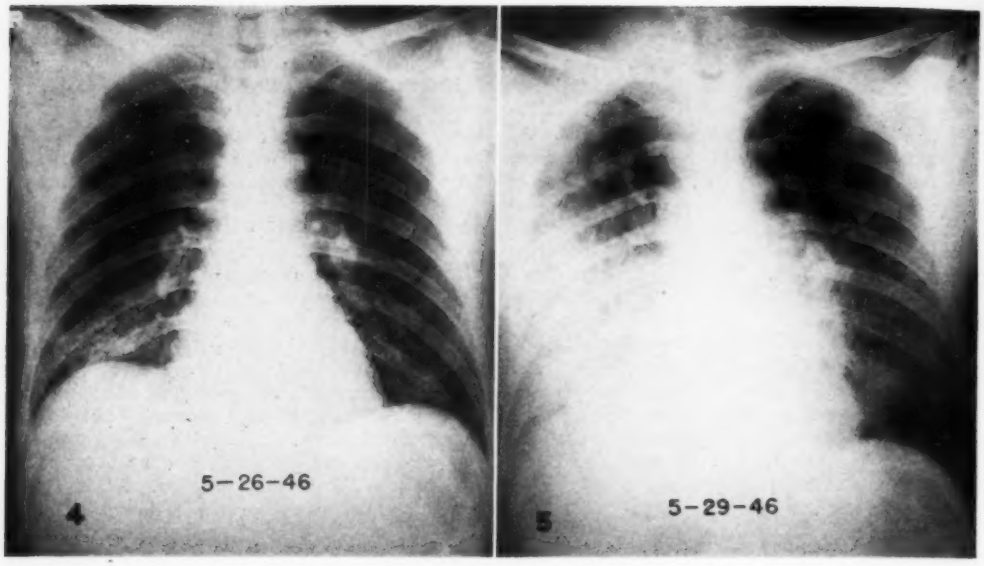
Agglutinations for typhoid, tularemia, brucellosis, and proteus OX-19 were negative. Agglutination for *Leptospirae* were reported as follows:

Date	Antigen	Titer
8/7/50	*L. icterohaemorrhagiae*	1:800
	L. canicola	1:1600
8/14/50	*L. icterohaemorrhagiae*	1:1600
	L. canicola	1:3200
8/21/50	*L. icterohaemorrhagiae*	1:1600
	L. canicola	1:1600

Comment: This case presented initially a diagnostic problem because the most impressive clinical findings were the marked hemoptysis and respiratory difficulty, along with disseminated pulmonary infiltrations on the chest roentgenograms. There was no evidence of renal involvement, jaundice, or muscle tenderness. When aseptic meningitis became evident, the diagnosis of leptospirosis was made with a greater degree of certainty. What part the individual antibiotics played in the abrupt and dramatic recovery from an almost moribund state is conjectural. The diagnosis was confirmed by agglutination studies. The titer was slightly higher for *L. canicola* than for *L. icterohaemorrhagiae*, although the patient gave the history of a rat bite.

CASE II: W. Mc., a 45-year-old white male, was admitted to Emory University Hospital on May 16, 1946, complaining of fever of four days duration.

He had been in good health until four days before admission, when he suffered a chill followed by fever of 101° to 104°. Sporadic chills continued, with bitemporal headache, pain in the knees, anorexia,



Figs. 4 and 5. Case II.
Fig. 4. Localized consolidation in right lower lung. Fig. 5. Marked increase in size of the consolidation. At autopsy this was shown to be due to intrapulmonary hemorrhage and edema.

constipation, and polyuria. There was some dull pain in the left flank, and on one occasion there was burning on urination. The patient had had no rash, jaundice, or chest pain. The day before admission a dry, hacking, non-productive cough developed. There was no history of contact with rats or dogs, although the patient said there were rats in a wooded lot near his home.

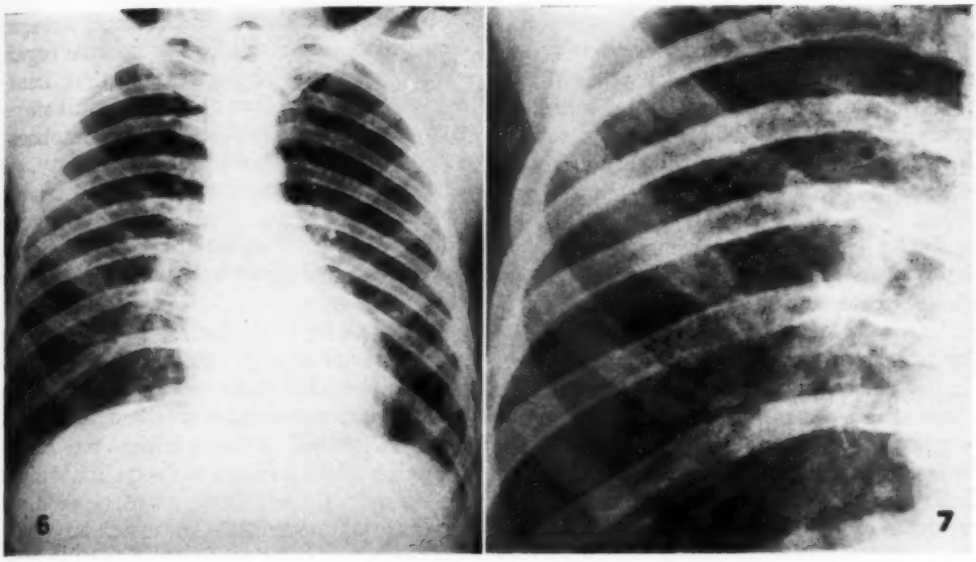
The temperature was 103°, pulse 92, and respiratory rate 20. The patient was acutely ill, but well nourished, cooperative, and had a clear sensorium. The conjunctivae and pharynx were markedly injected. There was no icterus, rash, petechiae, or muscle tenderness. The posterior cervical and occipital nodes were enlarged and discrete. The axillary and inguinal nodes were also enlarged. The chest was clear to percussion and auscultation. The liver edge was palpable, and there was mild costovertebral angle tenderness on the left. The clinical impression on admission was "fever of unknown origin." Possible diagnoses were listed as typhus, left perinephric abscess or pyelonephritis, malaria, septicemia (meningococcemia, etc.), and brucellosis.

The urine showed albumin 1 plus, 10 to 15 clumps of white blood cells, and bacteria 1 plus. The white blood cell count was 15,000, rising to 21,000 on the fifth hospital day, with 88 per cent polymorphonuclear leukocytes. There was slight but progressive anemia.

Treatment and Hospital Course: The patient received Penicillin and supportive therapy, but had a rapid downhill course, with progressive jaundice, anuria, and respiratory difficulty. On the eighth day there were dullness on percussion and diminished breath sounds over the right lung base. On the ninth day there was bronchial breathing over the right lower lobe. Skin bleeding time on this day was twelve minutes. The patient became more dyspneic, cyanotic, and comatose, and died on May 30.

Autopsy showed the typical generalized involvement of Weil's disease. Special stains demonstrated leptospiral organisms in the liver and kidney, and the muscle lesions were characteristic. Petechial hemorrhages were present in the cornea, epicardium, interlobar pleural surface, kidneys, and small bowel. A red-tinged icteric fluid was present in both pleural spaces, 600 c.c. on the left and 725 c.c. on the right. The lungs were heavy, with generalized extensive hemorrhage and edema. There were great numbers of erythrocytes and large amounts of edema fluid and frank fibrin filling the alveolar space. The right lower lobe did not appear significantly different from the remainder of the lung. An early bronchopneumonia was present.

Comment: This was a typical severe case of Weil's disease, with fatal termination. When admitted to the hospital, the patient presented a diagnostic problem because of "fever of unknown origin." Pulmonary symptoms developed concomitantly with evidence of other organ involvement. Roentgenograms showed an



Figs. 6 and 7. Case III.
Fig. 6. Diffuse small patchy pulmonary infiltrations. Fig. 7. Closer view of these "miliary" lesions (right lower lung).

area of consolidation in the right lower lung (Fig. 4), which increased markedly in size (Fig. 5), as a result of intrapulmonary hemorrhage and edema. At autopsy leptospirae were demonstrated in the liver and kidney.

CASE III: T. C., a 31-year-old carpenter, was admitted to Lawson VA Hospital on May 3, 1948, complaining of fever and headache. Three weeks previously he had experienced a gradual onset of back pain, located over the kidney and lumbosacral regions, followed by malaise and generalized muscle aches and pains. Ten days prior to admission fever appeared. Five days later, nausea, vomiting, anorexia, epistaxis, and hemoptysis developed, and the temperature rose to 103–105°. Three days before admission the urine became darker, and the patient was drowsy. He continued to have fever, daily nosebleeds and small hemoptyses until the day of admission, when he became sicker, with headache, chilly sensations, and mild jaundice.

The patient appeared acutely ill, "slightly euphoric, drowsy, but oriented and cooperative." The skin was slightly icteric. There was moderate stiffness of the neck and the nasal mucosa and throat were erythematous. Medium moist râles were audible over both lung fields posteriorly and laterally. There was slight costovertebral angle tenderness.

Examination of the urine showed it to have a specific gravity of 1.010, with albumin 2 to 4 plus and numerous coarse granular casts. The initial white blood cell count was 6,500 with 76 per cent neutrophils, rising three days later to 12,000 with 90 per cent neutrophils. The non-protein nitrogen was 48 mg. per cent, cephalin flocculation 4 plus, icterus index 11, thymol turbidity 7.1 units, serum bilirubin 1.5 units. Lumbar puncture four days after admission showed the spinal fluid to be slightly xanthochromic, with 180 white blood cells with 89 per cent lymphocytes. A muscle biopsy (gastrocnemius) was reported microscopically "compatible with but not diagnostic of Weil's disease." Agglutination for *L. icterohaemorrhagiae* was positive 1:320; for *L. canicola* negative.

A chest roentgenogram (Figs. 6 and 7) taken the day after admission revealed diffuse small patchy infiltrations throughout the lower three-quarters of both lung fields. These were quite similar in appearance to those in Case I (Fig. 1). The roentgenologist attributed these findings to a "bilateral bronchopneumonia."

Hospital Course: The patient was given Penicillin, 50,000 units every three hours, intramuscularly. He remained moderately ill and uncomfortable until the fourth day, when the temperature fell toward normal. Thereafter he made a steady and uneventful recovery.

Comment: In the course of typical Weil's disease, there developed in this patient a hemorrhagic pneumonia, manifested roentgenographically by disseminated small pulmonary infiltrations quite similar in appearance to those in Case I.

DISCUSSION

This discussion is confined to the pulmonary findings, since most other manifestations of leptospirosis have been elaborated elsewhere. The following review has been compiled from the scattered references in the literature and from our personal experience.

Pathology: The pulmonary changes in leptospirosis consist chiefly of a hemorrhagic pneumonitis. There may be petechiae or ecchymoses scattered through the lungs, pleura, and tracheobronchial tree. In advanced cases there are localized or generalized areas of extensive intrapulmonary hemorrhage and edema. Confluent patches of hemorrhage may resemble infarcts. Microscopic examination reveals no evidence of a primarily inflammatory process, although there may be areas of leukocytic infiltration and active phagocytosis. Spirochetes have not been recovered from the lungs. Bronchopneumonia is a frequent complication in the seriously ill. The lungs are sometimes normal in appearance.

Pathogenesis: The pathogenesis of this hemorrhagic pneumonitis is not definitely known. It is believed to be a consequence of the toxemia (with widespread capillary damage and hemorrhagic tendency) that occurs in leptospirosis. It occurs most often around the onset of the second ("toxic" or "icteric") stage. There may be a mensurable increase in capillary fragility and alteration in the prothrombin time and blood platelet level. The latter, however, are not usually lowered to a degree sufficient to explain the hemorrhagic phenomena.

Symptoms and Physical Signs: There is no conclusive evidence from the literature as to the incidence of cough and hemoptysis. During the first stage, a cough, which may be slightly productive, develops in from 5 to 40 per cent of the patients. This occurs along with "flu," "grippe," or "bronchitis" symptoms. (All the organs are involved to some extent during this leptospiremia, which lasts from three to seven days.) The cough may appear first at the onset of the second ("toxic") stage, along with evidence of other specific organ involvement. The impression that hemoptysis does not often occur until this stage will have to be answered by future observations. Hemoptysis is usually scanty.

Physical examination of the chest may reveal the presence of râles, locally or generally, and signs of consolidation. Occasionally a pleural or pericardial friction rub is encountered.

Roentgenologic Features: The roentgen manifestations may consist of (*a*) small patchy localized infiltrations which have the appearance usually ascribed to "bronchopneumonia," or more linear or segmental infiltrations such as are seen in atypical pneumonia, (*b*) confluent, larger (even massive) areas of consolidation which have the appearance of pneumonia, pulmonary edema, or parenchymal hemorrhage, or (*c*) widely disseminated small infiltrations, previously described. No sharply delineated lobar or segmental types of consolidation, such as are classically seen in pneumococcal pneumonia, have been reported. There may be a small amount of pleural effusion.

The only previously published paper on pulmonary infiltrations in leptospirosis is a report of cases by Moeschlin (12) from Zürich in 1943. He described multiple patchy infiltrations in the lung fields of 4 patients with proved Weil's disease, and included reproductions of roentgenograms in 2 of these. The first patient differed from the rest in that the pulmonary symptoms were pronounced and the pulmonary infiltrations were located primarily in the mid-lung fields. Cough and scanty blood-streaked sputum occurred concomitantly with the second stage of the disease, with signs of hepatitis, further fever, etc. The other 3 patients had minimal pulmonary symptoms, but exhibited patchy infiltrations at both lung bases. Part of these could have been due to secondary bronchopneumonia or incidental atelectasis. Necropsy on the fourth patient revealed extensive bleeding into the lung parenchyma with early pneumonic infiltration.

In the first case of Weil's disease diagnosed in Atlanta (1943), the radiographic finding of an "area of peribronchial infiltration in the lower lobe of the right lung" was interpreted as "pneumonia." Autopsy again demonstrated that this infiltration was due entirely to hemorrhage and edema.

Havens *et al.* (10) also described areas of "pneumonic consolidation" in the roentgenograms of 2 of 7 young men who had acquired Weil's disease by bathing in contaminated water. One of these 2 severely ill patients was admitted to the hospital with dyspnea, cyanosis, jaundice, and hemorrhagic phenomena. Physical findings of pneumonic consolidation in the lower lobes were confirmed by the chest roentgenogram. Postmortem examination revealed "a peculiar irregular type of consolidation due to extensive hemorrhage in the lower lobes of the lungs."

Gsell (9) noted that "fleeting lung infiltrations" without physical symptoms may be seen in this disease. We have not been able to demonstrate this finding in any of our cases.

We have had the opportunity of reviewing the clinical charts and chest roentgenograms of 33 patients with proved leptospirosis. Six of these cases have recently been reported in the literature (2, 4) from the standpoint of aseptic meningitis. Twenty-six patients (79 per cent) had typical Weil's disease. Nine (34 per cent) of these complained of cough, and 6 of hemoptysis. Chest roentgenograms taken of 6 of the 9 symptomatic patients revealed pulmonary infiltrations in 4. One of these showed small disseminated infiltrations (Case 3); 1 a large area of localized consolidation (Case 2); 1 "atypical pneumonia" at one lung base; and 1 "basal bronchopneumonia." Roentgenograms on 10 patients without pulmonary symptoms revealed no infiltrations.

Two patients (6 per cent) had clinical manifestations chiefly of hemorrhagic pneumonitis and aseptic meningitis. One of these showed disseminated infiltrations (Case 1).

A routine chest film was normal in 1 of 5 patients (15 per cent) who had aseptic meningitis as the only clinical finding.

SUMMARY

1. Leptospirosis occurs with sufficient frequency in this country that it should be considered in the differential diagnosis of any acute febrile illness accompanied by one or more of the following features: jaundice, nephritis, aseptic meningitis, hemorrhagic pneumonitis.

2. Pulmonary involvement, in the form of a hemorrhagic pneumonitis, is occasionally an early or most striking clinical manifestation of this disease. For this reason, it should be of particular interest to roentgenologists.

3. The case histories and chest roentgenograms of 33 patients with leptospirosis were reviewed. In 2 cases the roentgen changes consisted of localized or segmental "bronchopneumonia"; in 2, of widely disseminated small pulmonary infiltrations, and in 1, of a massive area of consolidation.

4. Postmortem examination in 2 cases demonstrated that the radiographic findings, which were interpreted as "pneumonia," were due to pulmonary hemorrhage and edema.

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SUMARIO

Manifestaciones Pulmonares de la Leptospirosis

La leptospirosis alcanza suficiente frecuencia para ser considerada en el diagnóstico diferencial de toda afección febril aguda que vaya acompañada de ictericia, nefritis, meningitis séptica, o neumonitis hemorrágica.

La invasión pulmonar, en forma de neumonitis hemorrágica, constituye de vez en cuando una manifestación clínica temprana o de lo más notable en dicha enfermedad, por lo cual debe revestir interés especial para los roentgenólogos.

Repásanse aquí las historias clínicas y radiografías torácicas de 33 enfermos con leptospirosis. En 2 casos, las alteraciones roentgenológicas consistían en "bronconeumonía" localizada o segmental; en 2, en infiltraciones pulmonares pequeñas y ampliamente diseminadas; y en 1, en una zona masiva de hepatización. El examen autópsico en 2 casos reveló que los hallazgos radiográficos, interpretados como "neumonía," correspondían a hemorragia y edema pulmonares.

Roentgen Study of Urethrovesical Relationships in Female Urinary Stress Incontinence[1]

C. PAUL HODGKINSON, M.D., and HOWARD P. DOUB, M.D.

THIS REPORT IS based upon comparative roentgen studies of the female urethra and bladder in three distinct groups. Group 1 was made up of normal non-parous women. The patients of group 2 had no urinary complaints but did show varying degrees of relaxation of the support of the lower urinary tract as the result of parturition. Group 3 was composed of patients complaining of urinary stress incontinence.

Two phases of bladder physiology were investigated—resting and straining. Both anteroposterior and lateral roentgenograms were taken, and, when operation was performed, preoperative and postoperative urethrocystograms were studied.

A modified urethrocystographic technic was used, which furnished excellent contrast in both the lateral and anteroposterior views. It had the further advantages of simplicity, accuracy of detail, and avoidance of distortion. This procedure required the cooperation of the Departments of Gynecology and Radiology. The patient was prepared for roentgen examination in the gynecological clinic.

Skiodan was used for demonstration of the bladder outline. The configuration of the urethra was demonstrated by means of a metallic bead chain of the type commonly used for carrying keys. This chain measured 25 cm. in length. The beads were 3 mm. in diameter and were separated by connecting rods 1.5 mm. in length. For insertion of the chain, an 18 French soft rubber catheter was bisected longitudinally. The other apparatus consisted of the usual instruments for sterile catheterization of the female.

The procedure for insertion of the chain was easily mastered. The patient was draped as for sterile catheterization. The chain was fitted into the inside lumen of the bisected catheter with the first bead extending over the catheter tip. The entire catheter was lightly lubricated with jelly and inserted into the urethra for a distance of 12 cm. As the catheter was further introduced, the external end of the chain was held taut to liberate it from the catheter, which could then be withdrawn, leaving the chain in place in the urethra and bladder. The bladder was emptied of urine with a glass catheter, and 60 c.c. of 15 per cent Skiodan was instilled. A metallic marker applied to the side of the external urinary meatus served to identify the terminal end of the urethra. The patient was then transported by wheel chair to the radiological department.

The first important factor in obtaining a satisfactory roentgen examination is a sympathetic attitude on the part of the technician, so that she can gain the confidence of the patient. Not only is the patient uncomfortable, but she has the added fear of expelling the contents of the bladder.

All of the films are exposed with the patient standing. Exposures are made in the anteroposterior and lateral positions with the tube focused at the level of the upper border of the symphysis pubis. Two sets of films are obtained: one set in the quiet or non-straining position and the other set with the patient straining. Care should be exercised that both non-straining films be made first, as the bladder does not immediately return to the normal non-straining position.

It is desirable that the target-film distance be not less than 36 inches. In order to obviate the effect of motion on the film, the exposure time should be as short as possible consistent with good detail.

[1] From the Department of Gynecology and Obstetrics and the Department of Radiology, The Henry Ford Hospital, Detroit, Mich. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

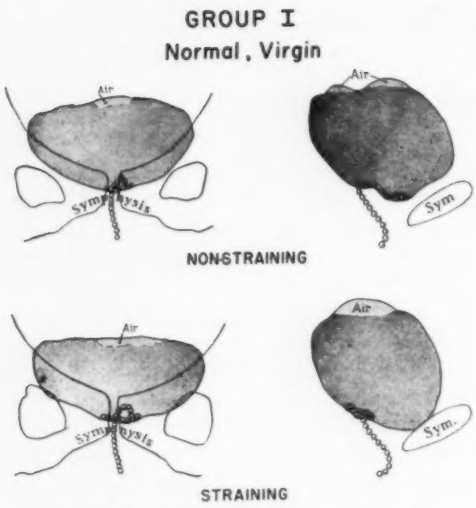

Fig. 1. Group I: Normal non-parous subjects.

The technical roentgenographic factors will vary considerably, according to the size of the patient.

In this fashion, excellent roentgen detail was obtained. Urethral configuration and bladder outline were sharp and undistorted in both the anteroposterior and lateral views. The dynamic effects of straining were clearly evident.

Comparison of the altered relationships of the urethra, bladder, and symphysis pubis was made by contrasting the normal urethrocystograms with the abnormal. For the purpose of illustrating this report, all film details have been eliminated except those of the bladder, urethra, and symphysis pubis. These structures were traced by the medical artist on thin tissue paper and transferred to appropriate contrast paper for photographing.

GROUP I: NORMAL ASYMPTOMATIC PATIENTS (Figure 1)

In normal non-parous patients the anteroposterior view showed the bladder to be ovoid in shape, with its inferior border at the mid-pubic level. The urethra was in the mid-line. Straining caused slight flattening of the superior border of the bladder and descent of the bladder floor to the level of the lower third of the symphysis.

In the lateral position, the anterior third of the bladder was shown to occupy an area over the symphysis, while the urethra ran obliquely forward in a rather straight line to the distal end, where it curved

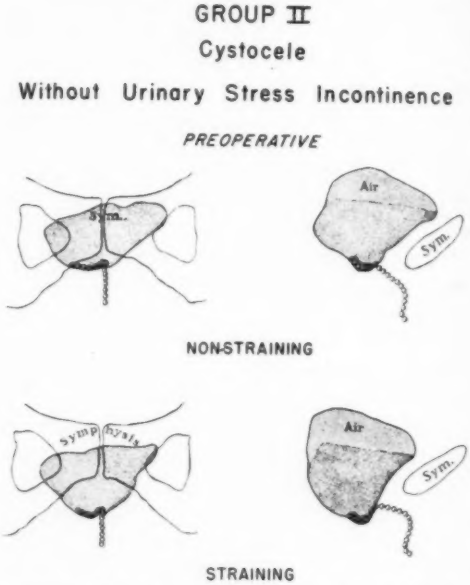

Fig. 2. Group II: Cystocele. This patient had a moderately large cystocele, but exhibited no symptoms of urinary stress incontinence. Urethrocystograms demonstrated a partial posterior defect of bladder floor support. Upon straining, the bladder rotated backward and downward. The internal urinary meatus was assimilated into the anterior bladder wall above the level of the most depressed portion of the bladder floor.

downward. If, on this view, the bladder was divided into thirds, the internal urinary meatus was found to be located at the junction of the posterior and middle thirds. Straining caused little alteration in the relationships of the urethra, bladder, and symphysis, although in one patient there was suggestive evidence that the bladder rotated forward and downward toward the symphysis.

GROUP II: LOSS OF MECHANICAL SUPPORT OF BLADDER FLOOR (Figures 2–4)

It is a curious fact that patients may

suffer extensive loss of support of the floor of the bladder and the urethra and still have no symptoms of urinary stress incontinence. The clinical degree of relaxation varies from a slight cystocele to complete prolapse of the anterior vaginal wall. For purposes of comparison, two variations

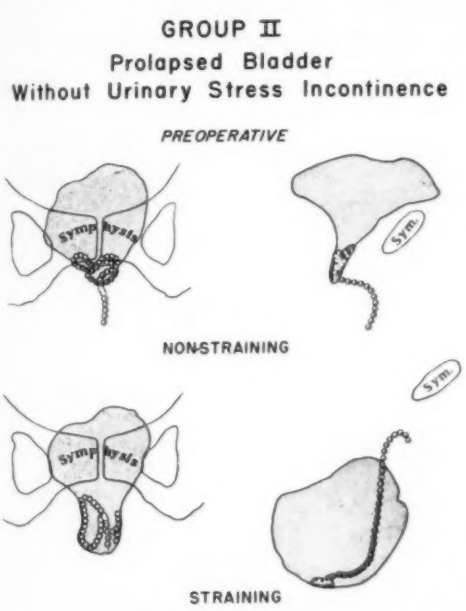

Fig. 3. Group II: Prolapsed bladder. This patient, upon straining, displaced the bladder through the vaginal introitus. Unless she manually replaced the bladder, voiding was not possible. Urethrocystograms demonstrated complete rotation of the bladder.

of this common condition are illustrated.

Preoperative Urethrocystograms (*Figs. 2 and 3*): The preoperative roentgen findings in this group of patients were consistent but variable. The anteroposterior view showed the bladder to be located at a considerably lower level than normal. Straining caused its displacement to a still lower position, varying from a slight descent to complete displacement. The major loss of support appeared to be in the mid-line. Considerable excursion of the urethra was evident from roentgenograms taken in this position.

The lateral films disclosed alterations in the urethrovesical relationships. In the non-straining films the base of the bladder

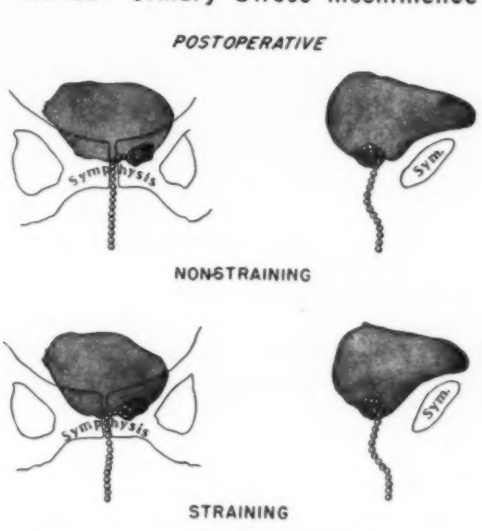

Fig. 4. Group II: Prolapsed bladder (postoperative). The postoperative results of surgical repair of the bladder floor are demonstrated in the patient shown in Fig. 3.

appeared to be conical, with the internal urinary meatus at the apex of the inverted cone in the mid-bladder plane. Straining caused downward and backward rotation of the bladder. As the result of this, the internal urinary meatus was assimilated into the anterior bladder wall. This was a variable but consistent finding in this group of patients. When a moderate cystocele was present, the meatus was located only slightly above the most depressed portion of the bladder base. In instances of complete prolapse of the anterior vaginal wall, the meatus was located at the upper border of the bladder shadow. The urethra appeared to be lengthened in patients suffering from relaxation of bladder support, varying from 12 beads (48 mm.) to 14 beads (54 mm.), as compared to a normal of 10 beads (40 mm.).

Postoperative Urethrocystograms (*Fig. 4*): Following operation for repair of the anterior vaginal wall, roentgenograms taken in the anteroposterior position demonstrated

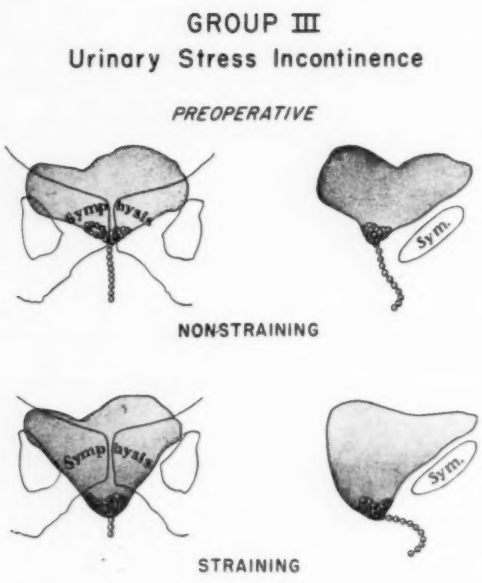

Fig. 5. Group III: Urinary stress incontinence. Vertical descent of bladder and urethra, without rotation, characterized Group III. At the peak of the straining effort, the internal urinary meatus was located at the most depressed bladder level. Vertical elongation of the bladder occurred as the result of straining.

restoration of bladder support. Straining caused slight descent of the bladder.

Lateral films confirmed the impression gained from the anteroposterior views. The junction of the urethra with the bladder base was in most instances nearly normal in position. The internal urinary meatus was located at the lowest bladder level, as in roentgenograms of normal subjects. The urethral configuration resembled the normal.

GROUP III: URETHROVESICAL RELATIONSHIPS IN URINARY STRESS INCONTINENCE (Figures 5–7)

The study of this third group was undertaken to compare the urethrocystographic relationships of patients suffering from urinary stress incontinence with those of parous and non-parous patients having no such complaint.

Although the symptoms of urinary stress incontinence are in some way related to parturition, gynecologists have not recognized a precise defect. Moreover, the surgical procedures which have been recommended for correction of stress incontinence are based upon two rather opposed physiological principles. In this report comparison has been made of preoperative

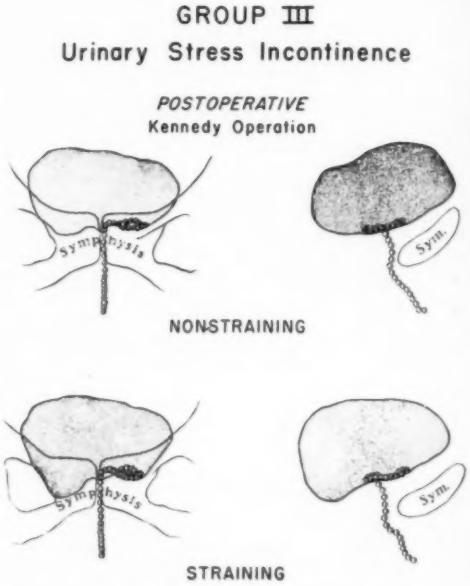

Fig. 6. Group III: Urinary stress incontinence (postoperative). After repair by the Kennedy modification of the Kelly operation, restoration of bladder floor support produced relationships resembling normal.

studies and films obtained following both types of operation.

Preoperative Urethrocystograms (*Fig. 5*): The anteroposterior films taken with patients not straining generally showed the bladder to occupy a slightly lower than normal position. The contour of the base of the bladder frequently assumed a somewhat pointed appearance, with the apex directed downward. The urethra occupied a mid position. Straining resulted in descent of the entire bladder. The bladder base plunged downward and the angle formed by the two walls of the base became more acute.

In the lateral non-straining films the bladder base appeared conical, with the internal urinary meatus located at the apex of the inverted cone in the mid-bladder

plane. The downward plunge of the bladder base was seen to be in a vertical direction, with little alteration in the relationship of the internal urinary meatus with the bladder base. This finding was consistently demonstrated in patients suffering from urinary stress incontinence, in sharp contrast to the findings in the other two groups.

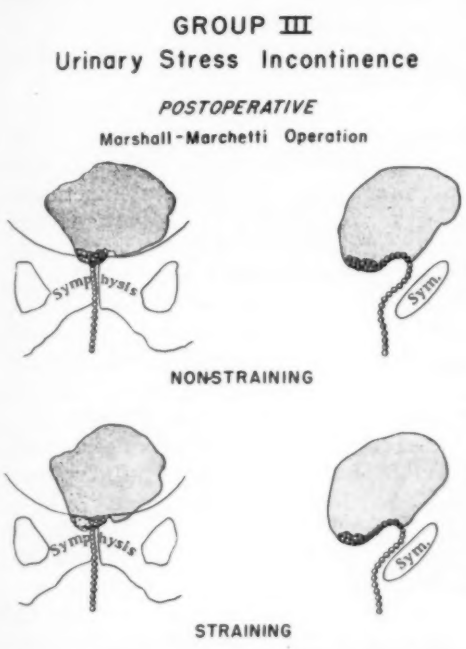

Fig. 7. Group III: Urinary stress incontinence (postoperative). When the Marshall-Marchetti procedure was used, the vesical neck was elevated and the bladder was rotated backward.

As a result of vertical displacement of the bladder by straining, the internal urinary meatus was always displaced to the lowest bladder level, where it was subject to maximum hydrostatic pressure.

Postoperative Urethrocystograms (*Vaginal Plastic Procedure*): The Kennedy modification of the Kelly procedure for correction of female urinary stress incontinence is a vaginal plastic operation. The significant details are plication of the paraurethral tissue and support to the subpubic angle. The internal sphincter is tightened by insertion of two or three mattress sutures. Anteroposterior urethrocystograms following this procedure disclosed the bladder to be well supported (Fig. 6).

In the lateral views the urethrocystographic findings resembled normal. The bladder occupied its normal position, and the urethra was shown to be well supported. The internal urinary meatus was located at the level of the bladder base and the urethra was straightened.

Straining produced very slight downward displacement of the bladder.

Operation resulted in a change of shape of the bladder. Preoperatively its vertical diameter was lengthened. Through operative support of the bladder floor, the vertical diameter was decreased.

Postoperative Urethrocystograms (*Vesical Neck Suspension*): The vesical neck suspension operations for correction of female urinary stress incontinence have as their major principle elevation of the vesical neck. By the use of fascia or other means, the vesical neck is elevated to a higher position, and in many instances the internal urinary sphincter mechanism is not repaired. The Marshall-Marchetti operation uses retropubic fixation of the anterior vaginal wall to accomplish the objective. This is performed through a lower abdominal incision.

The altered postoperative urethrocystographic relationships effected through the use of the Marshall-Marchetti operation are easily demonstrated (Fig. 7). On examination of anteroposterior non-straining views it was evident that the bladder was elevated. Straining resulted in little loss of support.

The lateral views showed the internal urinary meatus to be considerably elevated. The bladder was rotated backward, causing the internal urinary meatus to be located high on the anterior bladder wall, with the most dependent bladder level considerably below this point. Straining increased the backward and downward rotation of the bladder in its relation to the urethra, which was almost vertical in direction.

COMMENT

By definition, female urinary stress incontinence is the involuntary loss of urine as the result of exertion. It generally, but not always, follows parturition. It varies in degree from the loss of a few drops of urine to almost complete incontinence. The age of onset is usually between forty and fifty years.

Berkow (1) used the designation orthostatic incontinence for stress incontinence. He pointed out that, while it may be possible theoretically for stress incontinence to occur in either the horizontal or erect position, from a practical standpoint the horizontal position, by removing the effects of gravity, and perhaps by changing the position of the bladder, so reduces the forces of propulsion that true stress incontinence rarely occurs if the patient is lying down.

Roentgen methods have been used for many years in the study of stress incontinence. According to Johanson (2), Cunningham in 1910 first reported roentgen examination of the urethra with the aid of a contrast medium. Muellner (3) and Millin and Read (4) studied the physiology of micturition, using a liquid medium. Barnes (5, 6) in 1940 used a metallic bead chain to demonstrate urethral configuration, as suggested by Stevens and Smith (7). Ball (8) and others (9, 10) employed a soft rubber catheter filled with contrast medium. Use has also been made of thin rubber sheaths filled with a contrast substance (5, 6, 8).

The metallic bead chain technic as used in this study appears to offer advantages of importance. Patients can be studied in the erect position and be moved without fear of displacement of the device. Sufficient radiographic contrast is provided to obtain detailed roentgenograms in both the anteroposterior and lateral projections. Lacking substance except in the line of a direct pull, the chain produces a minimum of unrestricted urethral distortion. The bead intervals provide a relatively accurate means of measuring urethral length. Although the method is deficient in that it fails to show urethral mucosal pattern, this feature appears to be of little importance for the study of urethrovesical relationships.

In analyzing the results of this radiographic study, it is evident that lateral views provide the most information. Although anteroposterior views are of value, the superimposition of urethra and bladder obscures desired detail.

From the study of Group I, made up of normal non-parous patients, it is evident that the control of urine is dependent upon an intact and adequately functioning sphincter mechanism. The internal urinary meatus was found to be located at the most dependent bladder level, where it was required to support full hydrostatic pressure. On the lateral views, if the bladder was divided into thirds, the internal urinary meatus was found to be at the junction of the posterior and middle thirds.

Parturition causes two types of defect in support of the lower female urinary tract. Partial defects occur posteriorly and involve chiefly the bladder. Complete defects involve support to both the bladder and urethra.

Partial posterior defects were evident radiographically when not apparent clinically. In one parous patient without clinical evidence of loss of support, the urethrocystograms demonstrated posterior elongation of the bladder. This alteration in bladder shape caused a relative alteration of the urethrovesical relationships, as the internal urinary meatus was located in the mid-bladder plane. Partial posterior defects vary in degree from simple posterior bladder elongation, to clinically evident cystocele, to a disabling complete prolapse of the bladder.

Symptoms of urinary stress incontinence are not generally associated with partial posterior defects of lower urinary tract support. In fact, many such patients complain that they are overly continent. They find it necessary to replace the displaced organs manually before micturition is possible.

The radiographic studies have shown

that partial posterior defects are associated with downward and backward rotation of the bladder in its relationship with the urethra during the straining effort (Fig. 8). As a result of this action, the internal urinary meatus is assimilated into the anterior bladder wall and is elevated above the most dependent bladder level. Maximum hydrostatic pressure influences are thereby directed away from the internal sphincter mechanism.

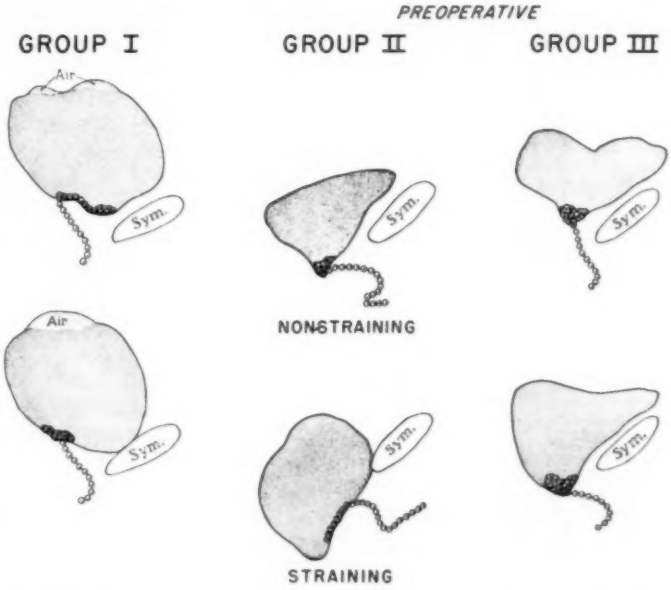

Fig. 8. Comparison of Groups I, II, and III. Lateral urethrocystograms (preoperative). When the defect characteristic of Group II was compared with normal Group I, it was evident that loss of support to the bladder floor was mainly posterior and only partially involved the urethra. Straining, under such circumstances, resulted in downward and backward rotation of the bladder.

When Group III was compared with Group I the defect appeared to involve the entire floor of the bladder and urethra. Straining caused vertical descent without rotation.

In complete loss of support to the lower female urinary tract, the urethra, as well as the bladder, is uniformly involved. Straining in such instances causes vertical downward displacement of the bladder with relatively little alteration in the urethrovesical relationships. At the peak of the straining effort, the internal urinary meatus is still located at the most dependent bladder level. In this location it must absorb maximum hydrostatic pressure influences. The sphincter mechanism of these patients is constantly bombarded by the hydrostatic influences of straining. The development of urinary stress incontinence in these circumstances resembles the gradual development of abdominal wall hernia in patients with fascial weakness.

Factors Involved in Urinary Continence of Parous Patients: As a result of these studies, three factors appear to be of importance in urinary continence in the female. The most important is an intact sphincter mechanism. The second is related to hydrostatic pressure. Whereas, vertical elongation of the bladder with the internal urinary meatus located at the most dependent bladder level frequently resulted in urinary stress incontinence, downward and backward rotation of the

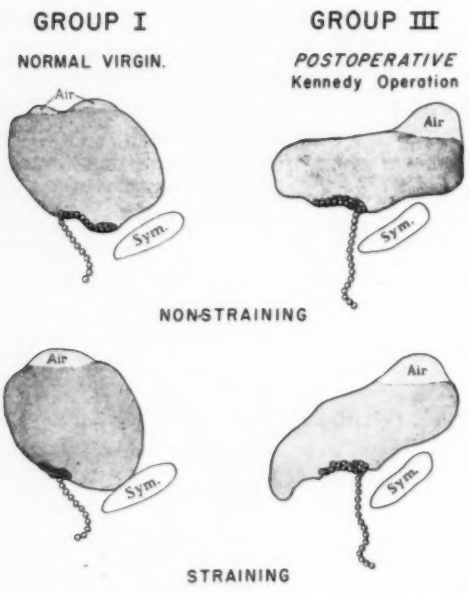

Fig. 9. Comparison of Group I and Group III, postoperative. The Kennedy modification of the Kelly operation strove for restoration of normal anatomy and physiology.

bladder, with assimilation of the internal urinary meatus to a higher position along the anterior bladder wall, was associated with complete continence. The third factor of possible importance was the "pinch" or "flutter valve" effect resulting from rotation of the bladder around a relatively well fixed urethra.

Operative Results (*Fig. 9*): Examination of the postoperative lateral urethrocystograms provided information of interest to the gynecologist. It is apparent that vaginal plastic operations, such as the Kennedy modification of the Kelly operation, strive for restoration of normal anatomy and physiology. Success of these procedures is dependent upon adequate repair of the sphincter mechanism.

With the vesical neck suspension operations, such as the Marshall-Marchetti procedure, an opposite physiological principle is involved. Urethrocystographic studies (Fig. 10) demonstrated that this operation accomplishes elevation of the internal urinary meatus with pronounced backward rotation of the bladder. In effect, the defect in lower urinary tract support is converted from a complete to a partial posterior defect, such as was noted in continent patients of Group II. Because the operation does not involve repair of the vesical sphincter, it is evident that its success depends upon alteration of hydrostatic pressure on the internal urinary meatus and the mechanical benefit of dislocating the internal urinary meatus to the anterior bladder wall.

It is apparent from these studies that many borderline conditions exist. The differential between a partial posterior defect and a complete defect is purely relative. In the borderline area many patients who have only minor degrees of urinary stress incontinence improve if the partial posterior defect increases as time goes on. On the other hand, some patients who are perfectly continent suffer from stress incontinence after simple repair of a cystocele. In such instances, bladder floor support prevents downward and backward rotation of the bladder, and the internal urinary meatus must assume the task of supporting full hydrostatic pressure.

Also, it appears likely that possible failure can be expected from any type of operative procedure recommended for urinary stress incontinence. A greatly relaxed, unrepaired sphincter mechanism would possibly prove inadequate, despite urethral suspension, in some instances. On the other hand, the sphincter mechanism may be so damaged that continence would not be restored after extensive repair.

SUMMARY AND CONCLUSIONS

Through the employment of the metallic bead chain technic for urethrocystography, the relationships of the urethra and bladder in the female were investigated. Undistorted urethral configuration was studied in relation to normal and disturbed bladder physiology. With this method it was possible to demonstrate radiologically the effects of parturition on lower urinary tract support when they were not apparent clinically.

Normal non-parous women depend chiefly upon an intact, adequately functioning sphincter mechanism for control of urine.

Parous patients without incontinence demonstrate, as the result of stress, backward and downward rotation of the bladder, with elevation of the internal urinary meatus to a position along the anterior bladder wall. Such activity brings the internal urinary meatus away from the point of maximum hydrostatic pressure.

Patients suffering from urinary stress incontinence demonstrate downward and vertical thrust of the bladder and urethra without rotation. Under such circumstances the internal urinary meatus remains in the area of maximum hydrostatic pressure during the straining effort.

Comments regarding surgical procedures recommended for relief of urinary stress incontinence are included.

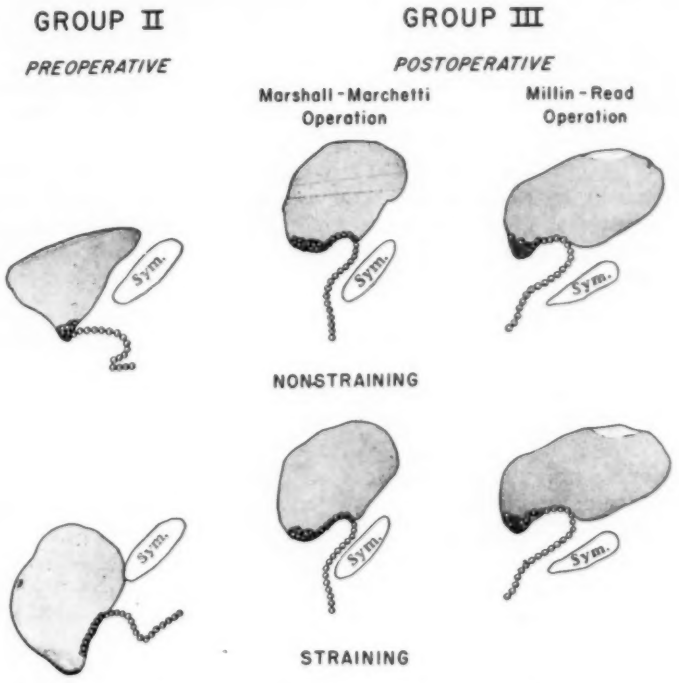

Fig. 10. Comparison of Group II and Group III, postoperative. The Marshall-Marchetti operation converted the bladder floor defect from complete to partial posterior, thereby causing posterior rotation of the bladder.

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SUMARIO

Estudio Roentgenológico de las Relaciones Uretrovesicales en la Incontinencia Urinaria de Esfuerzo en la Mujer

Por incontinencia urinaria de esfuerzo se entiende la pérdida involuentaria de orina a consecuencia del ejercicio. En la mujer, se presenta generalmente, pero no siempre, a continuación del parto, variando en intensidad de algunas gotas de orina a incontinencia casi total. La edad a la iniciación suele oscilar entre cuarenta y cincuenta años.

Mediante el empleo de una cadena de cuentas metálicas introducida en la uretra, se investigaron con la uretrocistografía las relaciones de la uretra y la vejiga en mujeres normales o que padecían de trastornos de la fisiología vesical. De este modo fué posible observar radiológicamente, cuando no eran evidentes clínicamente, los efectos del parto sobre los tejidos de sostén de la porción inferior del aparato urinario. Hiciéronse las siguientes observaciones:

(1) Las mujeres nulíparas normales están atenidas principalmente a un mecanismo esfintérico de funcionamiento adecuado para contener la orina.

(2) Las que han tenido hijos sin incontinencia muestran, a consecuencia del esfuerzo, rotación retrógrada o descendente de la vejiga, con elevación de la porción interna del meato urinario a una posición junto a la pared anterior de la vejiga, alejando así dicho meato del punto de donde se ejerce la presión hidrostática máxima.

(3) Las enfermas que padecían de incontinencia urinaria de esfuerzo revelaron proyección vertical descendente de la vejiga y la uretra sin rotación. En esas circunstancias, el meato urinario interno permanece en la zona de la presión hidrostática máxima durante el esfuerzo.

Empléanse dos clases de operación para aliviar la incontinencia urinaria de esfuerzo en la mujer. (1) Operaciones vaginoplásticas, con mira a restablecer la anatomía y fisiología normales, cuyo éxito depende de la reparación adecuada del mecanismo esfintérico; (2) operaciones de suspensión del cuello vesical, cuyo éxito se basa en la alteración de la presión hidrostática ejercida sobre el meato urinario interno y en el beneficio mecánico derivado del desplazamiento del meato a la pared anterior de la vejiga.

DISCUSSION

Allan C. Barnes, M.D. (Columbus, Ohio): Dr. Hodgkinson and Dr. Doub have presented us here with a very able study of the radiologically demonstrable changes encountered in women with urinary stress incontinence. Their purpose, quite obviously, has not been to advance a diagnostic roentgen study for these patients, but rather to use radiographic technics to further our understanding of the mechanisms involved in this distressing clinical entity.

The patient's chief complaint is incontinence; a careful history will differentiate urgency incontinence from stress incontinence, and the diagnosis is made, as is so often true in gynecology, "I have a prolapse; I am pregnant." The patient's chief complaint coincides with her final diagnosis. The routine use of x-ray studies of this type would not be diagnostically necessary, and is not, I am sure, contemplated by the authors. Since 1940 we have been using a somewhat similar technic. We have on occasion used this for diagnostic differentiation in difficult patients, but you need not anticipate, I would predict, that your clinicians will descend on you for a routine study of this type in all patients. This is a study seeking to demonstrate mechanical and physical changes in the bladder-urethra relationship in stress incontinence, and to record the positional restoration brought about by various surgical procedures.

Considered in the light of such objectives, there is much here which should be immediately commended. In the first place, the use of an intra-urethral chain remains the best technic for the visualization of the course of the undistorted urethra, and, taken together with a cystogram, gives the clearest possible view of the vesical-urethral junction. In the second place, the authors' insistence on having the patient standing is exceedingly important. The discussant's pre-

vious experience with such studies obtained with the patient recumbent, as well as the excellent tracings presented here, attest to the value of obtaining such films in the standing position. In the third place, a straining film, as the authors have used it, is imperative. A voiding film is actually of less value—one is concerned not with the vesical neck as the patient voluntarily empties her bladder, but with the relationship which exists under conditions of stress similar to those which produce the incontinence. Finally, the conclusion as to the essential defect as seen radiographically has much to recommend it.

The suggestions which have previously been offered as the result of roentgenologic studies of the partially continent woman have tended to be complex to the point of unreality. The observation that the essential defect is the transportation of the internal meatus to the most dependent point in the bladder—particularly when the patient is straining—offers a more logical and considerably simpler explanation.

There are, however, other points which will have to be considered before we have the entire explanation of the mechanism involved in stress incontinence. In the first place, one hopes that the authors will add another group of patients to their study, namely, the group of women with stress urinary incontinence, but without significant, if any, relaxation of the anterior vaginal wall. This is the smallest and rarest group, but it does exist, and the radiographic findings, both pre- and postoperative, would be of great interest.

In the second place, we must not relax in the belief that by determining position and positional changes we have determined all. It still remains true, in essence, that continence, for either the male or the female, exists when the forces tending to hold urine in the bladder exceed the forces tending to expel it. Incontinence will ensue whenever the forces of expulsion exceed the forces of retention. Essentially the derangement is one of altered physiology as much as of altered anatomic relationships. It is of value to know, as Drs. Hodgkinson and Doub have demonstrated, that the urethra is receiving the full impact of the expulsive stress. It would also be of value to have some measurement of this stressful force.

It is entirely possible that these two factors are automatically related, that the alteration in position as demonstrated in these films is invariably related to alterations in force. It would be helpful, however, if to the highly informative radiographic studies of the type we have seen, there could be added measurements of intravesical pressure and urethral sphincter strength.

Finally, another point may be raised. Too often the clinician turns to the roentgenologist only for diagnosis or for treatment. This work demonstrates a combined investigation into basic physiology. It is an approach which should be used more frequently, and the authors are to be congratulated for employing it so successfully. One hopes that it will lead to an expansion of the mutual approach to this and to other clinical problems.

Cystitis Emphysematosa

Review of the Literature and Report of Four Cases Diagnosed by Roentgen Examination[1]

JOSEPH E. FAINGOLD, M.D., CYRUS O. HANSEN, M.D., and LEO G. RIGLER, M.D.

CYSTITIS emphysematosa has received little attention; the paucity of literature regarding this entity is noteworthy. Mills (15), in 1930, first stimulated interest in the condition. He defined cystitis emphysematosa as an inflammatory condition of the urinary bladder associated with gas vesicles in the tissues.

The abnormal development of gas in body structures is not an unusual phenomenon, and various manifestations have been recognized. Pneumatosis cystoides intestinalis, for example, has been noted radiographically and at abdominal operations. Colpitis emphysematosa in women and emphysematous cholecystitis are of a similar nature. In all four conditions, gas is found in and about the tissues of the respective organs. While some differences are known to exist, it is of interest to speculate as to whether all—or at least all except the intestinal form— may not be analogous or in some way interrelated, constituting an entity, especially from a morphological and etiologic standpoint.

Until 1926, when Hueper (7) reviewed the reports of 11 cases—all found postmortem and unrecognized during life—the condition was practically unknown. Hueper's review mentioned reports by the following observers: Eisenlohr (6) in 1888 (1 case), De Camargo (5) in 1891 (1 case), Kedrowski (8) in 1898 (1 case), Ruppaner (27) in 1908 (1 case), Schönberg (29) in 1913 (3 cases), Nowicki (20, 21) in 1914 (4 cases).

No further reports appear in the literature until 1930, when Mills (15–19), with 12 autopsied and histologically studied cases personally observed, brought this entity to the attention of the medical profession. Such a group observed by one pathologist indicates that the condition is not as infrequent as it is ordinarily believed to be. An explanation will be offered presently which may account for its infrequent recognition and detection in life. Since Mills' observation in 1930, sporadic case reports have appeared.

Altogether, 48 cases of human cystitis emphysematosa have been reported. Of these, however, that is, two-thirds—all but 16—were found at autopsy. Indeed, it was quite controversial for a time as to whether this condition was merely a pathological finding due to postmortem changes or actually represented a true clinical entity. Although Mills' work was based entirely on autopsy findings, he wrote in 1930: "It is my growing conviction that this condition does exist during life and that eventually someone will discover and recognize it during routine examination of the bladder" (18).

Mills' prophecy was justified, for two years later Ravich and Katzen (24) first saw cystitis emphysematosa in a living subject. In their patient, an emergency cystotomy was done to control an intractable hemorrhage, and the condition was then recognized. Lautenschläger's (10) case, published in 1911, which also came to autopsy, is sometimes given precedence as being the first example seen antemortem, but there seems to be serious doubt as to its authenticity.

Since 1932, 14 other cases recognized during life have been reported: by Antoine (1) in 1934; Redewill (25) (2 cases) in 1934; Burrell (4) in 1936; Levin (11) in 1938; Lund, Zingale, and O'Dowd (12) in 1939; Wilhelm (33) in 1939; Mar-

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quardt (13) in 1940; Burns (3) in 1943; Ortmayer (23) in 1948; Teasley (31) in 1949; Maurer, Lich, and Burdon (14) in 1949; Bastecky, Holy, and Poch (2) in 1949; Milner, Garlick, and Mamonas (34) in 1952.

During the years 1947 to 1951, four cases of cystitis emphysematosa were encountered in hospitals in the Minneapolis area. All these cases were observed during life and diagnosed initially by roentgen examination.

ETIOLOGY

The problem of etiology has received some attention and is still somewhat controversial. It is generally believed that bacteria play an important role. These fall mainly into the *Bacillus coli* group; occasionally an anaerobe such as a *welchii* organism has been described. Bacteria of the *Bacillus coli* group have been demonstrated in the bladder wall or found on cultural examination by Eisenlohr, Schönberg and others (21).

Hueper's early report of 11 cases seen postmortem stressed infection with gas-producing organisms. In 3 of the 4 cases reported here, a gas-producing organism of the *coli* group was found; in the fourth, a urine culture was not done. An organism of the *B. coli* group was found in 11 of the 19 cases diagnosed antemortem; *B. welchii* was present in 2 cases, and both *B. coli* and *B. welchii* in 1 case, while in 5 cases no mention was made of an infectious agent. Nowicki contends that the organism may invade the bladder wall either by way of the blood stream or through lesions in the epithelium.

The role of hyperglycemia in the etiology is of interest. Hueper relates a very appropriate story regarding a dog in his laboratory whose bladder showed all the changes characteristic of cystitis emphysematosa. Examination of the abdominal organs showed a small rudimentary pancreas composed of glands with an acinar structure but without islands of Langerhans.

It can be said that the incidence of diabetes mellitus in cases of cystitis emphysematosa is quite high. For example, of our 4 patients, 2 were known to have had moderately severe diabetes for a number of years. Of the entire 20 cases diagnosed antemortem, 9 were in diabetics; there was no evidence of diabetes in 6 cases. In the remaining 4 cases, no mention was made of blood sugar determinations or urinalyses.

Schönberg points out that the increased sugar content of the blood as found in diabetes mellitus produces a favorable medium in the tissues for bacterial growth because under these conditions the sugar diffuses from the blood into the lymph and adjacent tissues. This may explain the relationship of cystitis emphysematosa to hyperglycemic states.

A rather convincing experiment was carried out by Burrell, in which he produced a chemical cystitis in a male rabbit by injecting a 20 per cent solution of silver nitrate into the urinary bladder. After two days, the bladder was infected with the organism isolated from a patient with cystitis emphysematosa. In addition, glycosuria was induced in the rabbit by injecting 10 per cent glucose intravenously every other day. An autopsy showed marked inflammation of the bladder with many small gas-containing vesicles in the mucosa. Organisms cultured from the bladder were the same as those of the original strain.

In addition to the etiologic factors mentioned, Redewill points out that there appear to be occasional cases of cystitis emphysematosa which are associated with a virulent generalized infection and in which the urinary bladder is infected secondarily by the gas bacillus. In some of these cases, the severe symptoms elsewhere mask the bladder condition. Mills reported a case of carcinoma of the stomach in which postoperatively a *B. coli* subphrenic abscess and cystitis emphysematosa developed; also a case of cholelithiasis with a postoperative *B. coli* generalized peritonitis associated with cystitis emphysematosa. H. Gideon Wells (32) describes a case of carcinoma of the rectum with a generalized peritonitis following resection, and here,

Fig. 1. Gross appearance of the urinary bladder in a case of cystitis emphysematosa. The mucosa of the bladder is virtually studded with many small gas-containing vesicles and the bladder wall is thickened and edematous. (From Mills, R. G.: Cystitis Emphysematosa. II. Report of a Series of Cases in Women. J.A.M.A. **94**: 321–326, February 1930. Courtesy of The Mayo Clinic and the *J.A.M.A.*)

too, cystitis emphysematosa was found postmortem. One of our cases (Case I) probably falls into this group.

PATHOLOGY

The gross pathology is usually characterized by the presence of many gas-containing vesicles in the bladder wall; the mucosa may be virtually studded with these small vesicles (Fig. 1). They vary in size from 1 to 3 mm. in diameter and may cover the entire organ uniformly. They appear as transparent rounded elevations which protrude into the lumen of the bladder and are present in the mucosa alone or in both the mucosa and submucosa. In some cases there is a dissemination of gas throughout the interstices of the connective tissue. The bladder, in addition, presents evidences of acute or chronic inflammatory changes, with hemorrhagic areas lying between the vesicles. The bladder wall is usually thickened as a result of associated edema.

On microscopic examination, there are seen gas-containing vesicles that extend almost to the free margin of the bladder wall (Fig. 2). These may be situated in the mucosa or submucosa, while in some cases gas infiltration is present throughout the whole wall of the bladder. Most of the vesicles have no cellular lining but are

Fig. 2. Microscopic appearance in cystitis emphysematosa. Several gas-filled vesicles are shown situated under the surface of the bladder mucosa and extending almost to the free margin of the bladder wall. (From Mills, R. G.: Cystitis Emphysematosa. II. Report of a Series of Cases in Women. J.A.M.A. **94**: 321–326, February 1930. Courtesy of The Mayo Clinic and the *J.A.M.A.*)

surrounded by several layers of homogeneous fibers. These are interpreted as being enlarged tissue spaces because of the lack of a cellular lining. Occasionally vesicles are seen which are lined by a single layer of endothelial cells, probably distended lymph channels. Epithelium has not been found in the walls of these vesicles, which tends to differentiate this condition from cystitis cystica. The vesicles often lie within an area of edema. Usually there is evidence of an associated cystitis. The abundance of leukocytic or lymphocytic infiltration indicates the acuteness or chronicity of the process. Hemorrhage is usually an associated finding. In some cases, iron-containing pigment is found, indicating that hemorrhage has taken place at some previous time and that the extrav-

asated corpuscles have undergone hemolysis.

The usual widespread distribution of the lesions over almost the entire bladder wall can be explained by the fact that the submucosa is normally loose, thus permitting the gas to spread to a considerable distance. In the region of the trigone the mucosa is more tightly adherent, so that only slight invasion of this region takes place.

CYSTOSCOPIC FINDINGS

The cystoscopic picture may be mentioned here because of its close correlation with the gross pathological findings. Lund, Zingale, and O'Dowd very vividly describe the appearance as seen through the cystoscopic lens. The vesicles are seen to be extremely thin-walled and, as they reflect the light of the cystoscope from their convex surfaces, they take on a characteristic silvery sheen and make an impressive picture (Fig. 3). During observation the vesicles can often be seen rupturing and sending bubbles of gas toward the dome of the bladder.

It may be well to emphasize here the transient state of the vesicles. Their rapid disappearance has been noted by a number of observers (4, 13, 28). Lund, Zingale, and O'Dowd state that in their case cystoscopy was repeated three days after the initial discovery of the lesion and the condition had subsided almost completely; in Burrell's case, the gas vesicles disappeared by the seventh day. The transient nature of the condition probably accounts in a large measure for its infrequent detection and recognition.

The analysis of the gas contained in these vesicles is of interest. Rosedale (26) showed it to be non-inflammable. Lund and his associates were able to collect the gas from the vesicles in a sealed tube and on three different occasions it proved to be carbon dioxide. Redewill devised a special apparatus by means of which he obtained the gas through a needle inserted into one of the vesicles, and then collected it by means of a catheter under water, to prevent admixture with any extraneous gases.

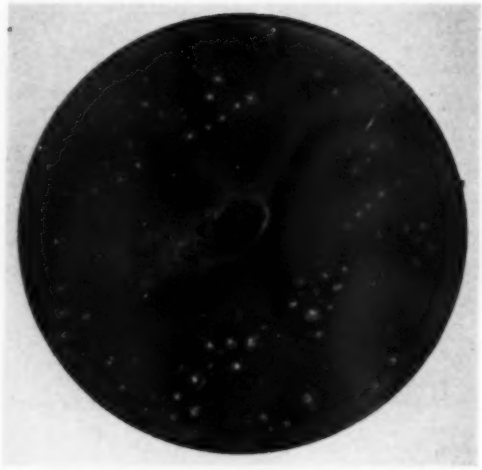


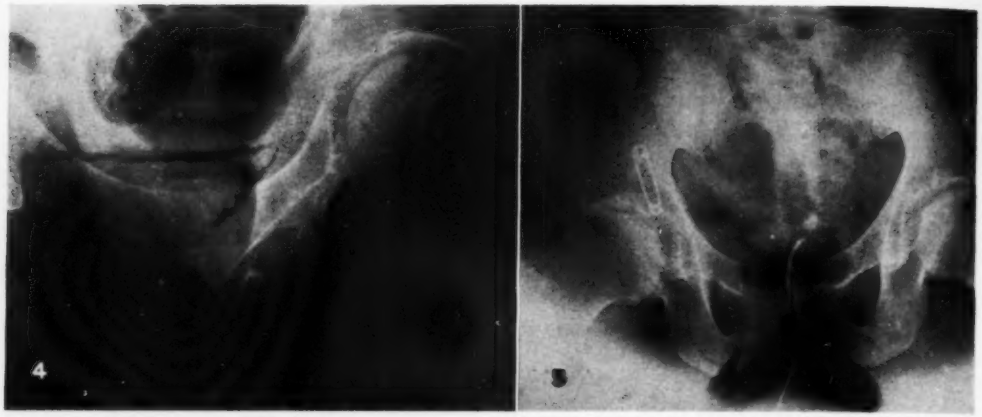
Fig. 3. Cystoscopic appearance of cystitis emphysematosa. The vesicles are thin-walled and take on a characteristic silvery sheen as they reflect the light of the cystoscope from their convex surfaces. Small hemorrhagic areas are present as well. (From Cystitis Emphysematosa. Report of a Case Found at Cystoscopy and Followed by Recovery. J. Urol. **42**: 684-688, November 1939. Courtesy of Dr. H. G. Lund, Dr. F. G. Zingale, Dr. J. A. O'Dowd and the *Journal of Urology*.)

As to the origin of the gas in the bladder wall, Olt (22) offers the explanation that enzymes which are produced by the bacteria in the urine and absorbed into the wall may be responsible for the splitting off of carbon dioxide from the carbohydrates present.

SYMPTOMATOLOGY

Cystitis emphysematosa is predominantly a disease of adult life, only 2 cases in childhood having been reported, one in a girl twelve years of age and another in a three-month-old infant.

In those cases diagnosed by cystoscopy or radiography, a colon bacillus hemorrhagic cystitis was the usual cause for investigation. Common symptoms were frequent urination and dysuria, with hematuria at times. Rarely pneumaturia was present. The first suspicion of such a lesion was occasionally seen in a scout film of the abdomen or following urography. Some of the cases were found in untreated diabetics with high blood sugars. How-



Figs. 4 and 5. Case I. Fig. 4 is a roentgenogram of the lower abdomen obtained July 20, 1949. An irregular semilunar ring of radiolucency outlining the circumference of the urinary bladder, due to gas within the bladder wall, is well shown.

Fig. 5 is a roentgenogram made on the following day. A marked diminution in the radiolucent gas shadow within the bladder wall has occurred in this short interval, indicating the transient nature of this condition. Some residual gas, however, still remains.

ever, normal blood sugar levels have been reported. In some cases there were no symptoms referable to the urinary bladder.

ROENTGEN FINDINGS

The radiographic findings are usually quite characteristic and offer an important diagnostic aid. As noted above, the first suspicion of this lesion may be aroused by a scout film of the abdomen. There is usually a concentric or semilunar ring of radiolucency outlining the circumference of the urinary bladder, obviously the result of gas within the bladder wall. Occasionally only a portion of the viscus is involved, but in most cases the zone of lesser density surrounds the bladder completely. Gas may often be demonstrated within the lumen of the bladder as well. The radiolucent zone may at times appear less confluent and more bubble-like in nature. When the bladder contracts, the zone of gas follows the bladder wall and may disappear entirely due to the rupture of the thin-walled vesicles and expulsion of their gas content.

The transient state of this condition has already been mentioned but cannot be too strongly emphasized.

REPORT OF CASES

CASE I: A white male, aged 51, was admitted to the University of Minnesota Hospital on May 11, 1949, complaining of pain in the abdomen, recurrent hematemesis, and an associated 40-pound weight loss. Epigastric pain had been present periodically since August 1946.

A gastrointestinal study revealed a large rigid gastric ulcer in the pars media, considered to be malignant. At surgery, on May 13, 1949, a carcinoma was found and a gastrectomy, along with a partial pancreatectomy, partial left adrenalectomy, and splenectomy, was performed. The patient made an uneventful recovery, following which he was discharged.

On July 20, 1949, the patient was readmitted with signs of intestinal obstruction. The lower abdomen was markedly distended and tender to palpation. No masses were palpable.

Roentgen examination of the abdomen at this time (July 20, 1949) revealed marked distention of the colon with gas, with only a moderate amount of gas in the small bowel. There was evidence of some fluid in the peritoneal cavity. Numerous bubble-like shadows were seen scattered about, and the possibility of small pocketed abscesses was considered. In the pelvis, there was a striking picture, with the presence of an irregular semilunar shadow of gas corresponding well to the wall of the urinary bladder (Fig. 4). It was felt that the findings were indicative of cystitis emphysematosa along with multiple intra-abdominal abscesses.

The urine was dark in color, contained a large number of red blood cells, and many pus cells. It was negative for sugar, although a 1 plus sugar had been reported on urinalysis during the earlier period of hospitalization. The urine culture was positive for *E. coli* and beta streptococci. There was a leukocytosis of 21,000 with 92 per

cent neutrophils. Unfortunately, a blood sugar determination was not done.

Roentgen examination of the abdomen on July 21, 1949, revealed a diminution in the radiolucent gas shadow within the bladder wall (Fig. 5) and on July 28, 1949, this shadow had completely disappeared.

Exploratory laparotomy revealed multiple intra-abdominal abscesses with a large amount of foul-smelling bloody fluid and gangrenous necrosis of portions of small bowel and ascending colon. These portions of bowel were resected, and end-to-end anastomoses were performed. The patient made a surprisingly good postoperative recovery and was discharged home twelve days later.

The patient's third and final admission, Aug. 8, 1949, was necessitated by separation of his wound, with a profuse foul-smelling discharge. While in the hospital, he had several convulsive seizures, became mentally confused, then semicomatose, and expired on Aug. 14, 1949.

Autopsy revealed an intra-abdominal abscess in the right gutter and retrocecal area, chronic pyelonephritis and suppurative encephalitis. The bladder was described as being contracted; its wall was markedly thickened, and throughout the mucosa were numerous hemorrhagic areas.

The absence of vesicles in the bladder wall at autopsy, which was performed some three weeks after the roentgen findings described above, is not surprising, since the transient nature of cystitis emphysematosa has been noted on a number of previous occasions. Evidence of residuals of a chronic hemorrhagic cystitis, however, was found. We believe that the characteristic radiographic picture as well as the clinical and laboratory data are all in favor of the diagnosis of cystitis emphysematosa in this case.

The relationship of cystitis emphysematosa with intra-abdominal abscesses, the latter apparently due to the gas bacillus, is here brought out. Similar instances of this nature have been reported by Mills, Wells, and others. The presence of *E. coli* and beta streptococci in the urine of this patient we feel to be significant in relation to the cystitis emphysematosa.

CASE II: O. G., a 62-year-old male, was admitted to Northwestern Hospital, Minneapolis, on Nov. 3, 1949. He was a known diabetic and had been taking 40 units of protamine zinc insulin and 35 units of regular insulin. On a previous admission, in October 1949, he showed urinary symptoms with nocturia, dysuria, and the passage of air bubbles in the urine. At that time, he improved on symptomatic treatment.

Fig. 6. Case II. Roentgenogram of the abdomen. A concentric ring of radiolucency is well shown outlining the circumference of the urinary bladder almost in its entirety, due to gas-filled vesicles within the bladder wall. Note the overlying gas-filled loops of bowel.

On the morning of the present admission, the patient had noticed the passage of considerable bloody urine. In addition, he complained of cramping pains in the lower abdomen with abdominal tenderness. There was no distention, and bowel sounds were normal.

A preliminary film of the urinary tract made before excretory urography on Nov. 3, 1949, revealed a fairly characteristic halo of gas about the periphery of the urinary bladder (Fig. 6). As the bladder filled with contrast material, this shadow remained (Fig. 7). On the film following emptying of the bladder, the shadow was seen to contract with the bladder wall.

Urinalysis on Nov. 3 showed 3 plus sugar and 1 plus albumin, many red blood cells, and pus cells. Sugar in the urine varied from a trace to 4 plus during the hospital stay. Urine culture revealed *B. coli*. Blood sugar on Nov. 3, 1949, was 294 mg. per cent.

Cystoscopy, done on Nov. 4, revealed a "diffuse cystitis with typical findings of cystitis emphysematosa." There was believed to be some free air in the lumen of the bladder as well.

The patient was treated with antibiotics, Chloromycetin in particular, and his diabetes was brought under control. He made an uneventful recovery and was discharged from the hospital on Nov. 9, 1949.

Fig. 7. Case II. Roentgen examination of lower abdomen during excretory urography. As the bladder filled with contrast medium, the radiolucent zone remained visible, partially delineating the periphery of the bladder wall.

CASE III: A white female, aged 75, was admitted to Lutheran-Deaconess Hospital, Minneapolis, on May 31, 1947, with vomiting, colicky abdominal pain, and distention. In addition, there were frequency, dysuria, and some hematuria. The apparent intestinal obstruction was treated conservatively at first, by passage of a Miller-Abbott tube. In the meantime, on June 2, 1947, the patient received 1,000 c.c. of 5 per cent glucose intravenously and on the following day, 1,000 c.c. of 10 per cent glucose.

Roentgen examination of the abdomen (Fig. 8), June 4, showed a concentric ring of radiolucency outlining the circumference of the urinary bladder almost in its entirety, obviously due to gas within the bladder wall.

Urinalysis revealed 1 plus sugar on May 31, was negative for sugar on June 5, and again showed 1 plus sugar on June 7. Many red blood cells and pus cells were found in the urine specimens; urine cultures were not made.

On June 12, the patient was operated upon. Multiple adhesions between segments of bowel were separated, and a ventral hernia was reduced and repaired.

Following this, the patient made an uneventful recovery and was discharged on June 28, 1947.

CASE IV: C. B. W., a 28-year-old, white male, entered the Out-Patient Clinic of the Minneapolis General Hospital on Jan. 11, 1951, having passed blood in his urine for the previous two days. He had previously been admitted to the Hospital in 1948, at which time he was treated for a diabetic coma, and again in November 1950 for treatment of a diabetic polyneuritis. He was known to have had diabetes for some eight or nine years and had been on protamine zinc and regular insulin for some time. At this time, in addition to hematuria,

Fig. 8. Case III. Scout film of abdomen revealing a fairly characteristic halo of gas outlining the circumference of the urinary bladder almost in its entirety.

there was some associated dysuria and frequency. The urine was dark yellow, its specific gravity 1.025, sugar 4 plus, albumin 4 plus, with numerous red and white cells in the sediment. A smear of sediment revealed many gram-negative bacilli (*B. coli*).

A roentgenogram of the urinary tract (Fig. 9) made on the day of admission revealed gas outlining the urinary bladder circumferentially and apparently within its wall. The patient was offered hospitalization but refused, stating that he preferred to be treated in the Out-Patient Clinic. There his diabetes was brought under control. At the same time, he received antibiotics and chemotherapy and made an uneventful recovery.

SUMMARY

1. A review of the literature on cystitis emphysematosa is presented.

2. To date, 16 cases recognized during life are to be found in the literature.

3. To these, 4 new cases revealed by

roentgenographic examination have been added.

4. An analysis of the significant etiological and clinical data is presented.

5. The condition seems to be a transient one, which may account for its infrequent observation.

6. The roentgenographic examination provides an important and definite means of diagnostic aid, the findings usually being pathognomonic.

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Fig. 9. Case IV: Scout film of lower abdomen. A concentric zone of radiolucency outlining the urinary bladder circumferentially is well shown, due to gas within the bladder wall. Some free gas, bubble-like in nature, is apparently present within the lumen of the bladder as well.

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SUMARIO

Cistitis Enfisematosa: Repaso de la Literatura y Presentación de Cuatro Casos

La cistitis enfisematosa es un estado-inflamatorio de la vejiga urinaria, caracterizado por la presencia de numerosas vesículas llenas de gas en la pared vesical, ya en la mucosa sola o tanto en la mucosa como la submucosa. Un repaso de la literatura ha revelado 32 casos descubiertos en la autopsia y 15 diagnosticados antes de la muerte. A este último grupo agréganse ahora 4 casos.

En la mayor parte de los casos diagnosticados durante la vida del enfermo, se encontró un bacilo aerógeno del grupo del *B. coli*. La diabetes sacarina parece representar un factor contribuyente, existiendo en 2 de los 4 casos comunicados ahora.

El hallazgo radiográfico de un borde concéntrico o semilunar de radiolucencia que demarca la circunferencia de la vejiga es típico e indica el diagnóstico. A menudo también puede observarse gas dentro de la vejiga.

El estado es pasajero y con frecuencia cabe observar cistoscópicamente las vesículas abriéndose y lanzando burbujas de gas hacia la cúpula de la vejiga.

An Evaluation of Lateral Atlanto-Axial Displacement in Injuries of the Cervical Spine[1]

GEORGE JACOBSON, M.D., and DENIS C. ADLER, M.D.

ANTEROPOSTERIOR roentgenograms of the cervical spine obtained following trauma frequently show displacement of the lateral articular masses of the atlas with respect to those of the axis. There has been a tendency to discount this finding on the grounds that it can be produced by normal movement of the head and that it is often seen in the absence of injury.

Fig. 1. Unilateral medial displacement of the lateral articular mass of the atlas produced by rotation of the head in a normal individual.

We have not encountered in the literature any study correlating the various types of lateral displacement and the frequency of their occurrence in injuries of the cervical spine. This investigation was undertaken because it was our impression that these displacements are more significant than has been suspected.

Three separate types of motion are possible in the normal atlanto-axial joint: (*a*) With flexion of the neck, a slight degree of separation can be demonstrated between the dens and anterior arch of the atlas (3). This motion is not pertinent to our discussion and will not be considered further. (*b*) Rotation of the atlas about the dens is the main function of the atlanto-axial joint. During our present study it became apparent that we did not understand the exact anatomic relationship of the various bony parts during rotation. This will be the subject of further investigation. It is clear, however, that as a result of this movement the rotated articular mass is foreshortened in the anteroposterior projection and gives the appearance of medial displacement (Fig. 1). The amount of over-riding that can be produced varies from individual to individual, depending on the laxity of the joint capsule and ligaments. (*c*) Lateral movement of the atlas on the axis also takes place and, while sometimes difficult to demonstrate, is produced most easily by abduction of the head (2) (Fig. 2). Coutts (1), quoting Poirier and Charpey, stated that as much as 4 mm. lateral motion was possible. In addition to confirming these observations, Paul and Moir (4) noted lateral asymmetry in an appreciable number of normal individuals even when the head was in neutral position.

Fig. 2. Abduction of the head in a normal individual producing lateral movement of the atlas on the axis.

[1] From the Departments of Radiology of the School of Medicine, University of Southern California (G.J.) and the College of Medical Evangelists (D.C.A.), and the Los Angeles County Hospital. Accepted for publication in October 1952.

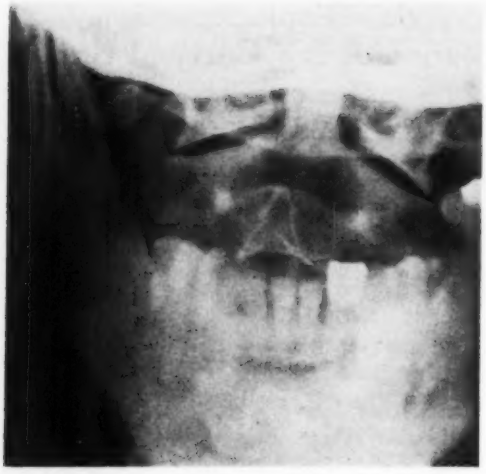

Fig. 3. Pseudo-offset caused by anomalous variation in size of adjacent articular surfaces.

A group of 200 consecutive patients who had suffered injury to the neck was studied. Only those for whom adequate anteroposterior roentgenograms of the atlas and axis were available, in addition to lateral views of the cervical spine, were included. Most of these roentgenograms were obtained very soon after injury and admission to the hospital. While many patients had more than one examination, only the first were used for this study. Several patients with congenital anomalies were eliminated because accurate analysis of their roentgenograms was impossible.

OBSERVATIONS

To describe asymmetry or over-riding of the articular surfaces of the lateral masses of the atlas and axis as seen in the anteroposterior projection, the term *offset* has been employed. The following types of offset were seen.

Unilateral offset: Lateral or medial displacement of one articular mass of the atlas with respect to the corresponding articular mass of the axis without apparent disturbance of the relationship of those of the opposite side (Figs. 4 and 6).

Bilateral offset: Unidirectional lateral displacement of both articular masses of the axis on the atlas (Fig. 7).

Bilateral spread: Displacement of the articular masses of the atlas in opposite directions (Fig. 8).

The following observations were made in each case: site of fracture or dislocation, type of offset, amount of offset, and degree of rotation and abduction of the head. The 200 cases studied were divided into the following three categories: (1) no evidence of fracture or dislocation; (2) fractures and/or dislocations of the third through the seventh cervical vertebra, (3) fractures and/or dislocations of the atlas and axis. The third group was subdivided into fractures and dislocations of (*a*) the arch and lateral mass of C-1, (*b*) arch and lateral mass of C-2, (*c*) the odontoid, (*d*) the body of C-2, and (*e*) anterior dislocation of C-2. In dividing the cases into these three groups, lateral displacement was not employed as a criterion of injury.

TABLE I. INCIDENCE OF OFFSET

Total cases of suspected injury to cervical spine	200
Total cases no offset	156 (78%)
Total cases offset	44 (22%)
Group 1. No evidence of fracture or dislocation	103
No offset	95 (92.3%)
Offset	8 (7.7%)
Group 2. Fractures and/or dislocations of C-3 through C-7	52
No offset	45 (86.5%)
Offset	7 (13.5%)
Group 1 plus Group 2	155
No offset	140 (90.3%)
Offset	15 (9.7%)
Group 3. Fractures and/or dislocations of atlas and axis	45
No offset	16 (35.5%)
Offset	29 (64.5%)

The amount of offset was estimated in millimeters. Offsets of less than 1 mm. were disregarded because of the frequent variations in size of adjacent articular surfaces. It is essential to differentiate these anomalous "pseudo-offsets," which occasionally may measure more than 1 mm., from the true offsets which are the result of movement of the atlas on the axis (Fig. 3). When a bilateral spread was present, the greater of the two offsets was recorded.

Abduction and rotation of the head oc-

curred simultaneously in so many cases that no attempt was made to analyze them separately. The degree of rotation and/or abduction was noted as being none, slight, or moderate.

Incidence of Offset: Although offset of the atlas on the axis occurs with normal movement of the head (Figs. 1 and 2), the diagnostic significance of the finding depends on its relative frequency in various injuries of the cervical spine (Table I). Offset occurred in 44 (22 per cent) of the entire group of 200 patients. The 103 patients who had none of the conventional roentgen signs of fracture or dislocation (Group 1) were considered a control group.

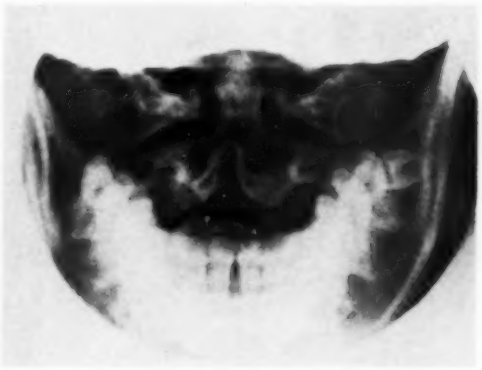

Fig. 4. Unilateral medial offset without evidence of fracture.

TABLE II. RELATION OF TYPE OF OFFSET TO LOCATION OF INJURY

	Total No. Cases	No Offset	Unilateral Medial Offset	Unilateral Lateral Offset	Bilateral Offset	Bilateral Spread
Group 1: No evidence of fracture or dislocation	103	95	4	1	3	
Group 2: Fractures and/or dislocations C-3 through C-7	52	45	5	1	1	
Group 3. Fractures and/or dislocations of atlas and axis	45	16	9	9	7	4
Arch and lateral mass C-1	10	1		5	2	2
Arch and lateral mass C-2	12	8	2		1	1
Odontoid	11	3	4	1	2	1
Body C-2	6	3	2		1	
Anterior dislocation C-2	6	1	1	3	1	

Only 8 (7.7 per cent) instances of offset were found in these cases. Even this low figure was probably greater than might have been obtained in an equal number of uninjured individuals, because of muscle spasm and possible unrecognized fractures and dislocations.

Group 2, consisting of 52 patients who had fractures and/or dislocations involving C-3 through C-7, showed an incidence of offset of 13.5 per cent (7 cases). In contrast to this, 64.5 per cent (29 cases) of the 45 patients of Group 3, with fractures and/or dislocations of the atlas and axis, showed offset. This latter figure can also be compared to an incidence of 9.7 per cent (15 cases) in all cases without roentgen evidence of injury to the atlas and axis, Group 1 plus Group 2.

Types of Offset: A total of 44 instances of offset were encountered (Table II): 18 unilateral medial, 41 per cent; 11 unilateral lateral, 25 per cent; 11 bilateral. 25 per cent; 4 bilateral spread, 9 per cent. There is a rather marked difference in the incidence of the various types of offset in Group 3 as compared to Group 1 plus Group 2:

Unilateral medial offset
  Group 3: 9 cases (20 per cent)
  Groups 1 and 2: 9 cases (6 per cent)
Unilateral lateral offset
  Group 3: 9 cases (20 per cent)
  Groups 1 and 2: 2 cases (1 per cent)
Bilateral offset
  Group 3: 7 cases (15 per cent)
  Groups 1 and 2: 4 cases (2 per cent)
Bilateral spread
  Group 3: 4 cases (7 per cent)
  Groups 1 and 2: No cases (0 per cent)

Unilateral medial offset can be produced without difficulty in the normal individual. It was also the most frequent type of offset in injuries of the cervical spine, and it occurred approximately three times as often in Group 3 as in Group 1 plus Group 2. Several of the patients who had uni-

Fig. 5. Unilateral medial offset associated with a chip fracture of the antero-inferior margin of the body of the axis. Note the absence of rotation of the head.

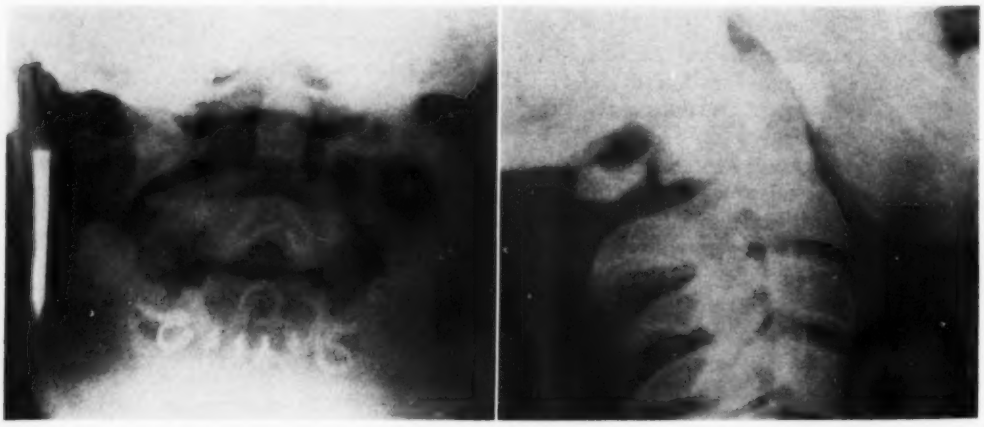

Fig. 6. Unilateral lateral offset associated with a fracture of the posterior arch of the atlas.

lateral medial offset without other evidence of fracture or dislocation had symptoms referable to the upper cervical spine and required treatment (Fig. 4). It is our suspicion that some of these cases may represent a rotatory dislocation as described by Coutts, "a pathologic fixation in a position within the normal range of motion." Unilateral medial offset was not seen in fractures or dislocations of C-1 but was rather uniformly distributed among the fractures and dislocations of C-2 (Fig. 5).

Lateral displacement of one articular mass of the atlas while the other remains fixed in relation to the axis requires interruption of the bony ring of the atlas. While 9 of 11 instances of unilateral lateral offset occurred in Group 3, in only 5 were

Fig. 7. Bilateral offset associated with a fracture of the posterior arch of the atlas.

fractures of the atlas actually visualized (Fig. 6); the sixth patient had a fracture dislocation of the odontoid, and the other 3 had anterior dislocations of C-2 on C-3. The remaining 2 cases of unilateral lateral offset occurred in Groups 1 and 2. The patient in Group 1 had severe neck pain, tenderness, and limitation of motion. He was treated by immobilization. The patient in Group 2 had advanced ankylosing spondylitis of the cervical spine and suffered a severe fracture dislocation of C-7. In those cases in which no fracture of the atlas was apparent we believe that an undetected fracture probably was present.

Although less frequently encountered, bilateral offset presented many of the features of unilateral medial offset. It occurred approximately seven times as frequently in Group 3 as in Group 1 plus Group 2. It was evenly distributed in various fractures and dislocations of the atlas and axis (Fig. 7). Its relation to rotatory dislocation is probably the same as that of unilateral medial offset.

All 4 instances of bilateral spread occurred in Group 3. It is accepted generally that this type of offset cannot occur in the absence of a fracture of the atlas. However, such a fracture was demon-

TABLE III: RELATION OF AMOUNT OF OFFSET TO LOCATION OF INJURY

	Total No. Cases	Amount of Offset (mm.)						
		0	1	2	3	4	5	10
Group 1: No evidence of fracture or dislocation	103	95	6	2				
Group 2: Fractures and/or dislocations C-3 through C-7	52	45	3	1	3			
Group 3: Fractures and/or dislocations of atlas and axis	45	16	5	11	6	3	3	1
Arch and lateral mass C-1	10	1		2	2	1	3	1
Arch and lateral mass C-2	12	8	2	1	1			
Odontoid	11	3		4	2	2		
Body C-2	6	3	1	2				
Anterior dislocation C-2	6	1	2	2	1			

Fig. 8. Bilateral spread. Arrow points to fracture of the lateral articular mass of the atlas.

TABLE IV: EFFECT OF ROTATION AND/OR ABDUCTION OF HEAD ON AMOUNT OF OFFSET

Rotation and/or abduction	Total No. Cases	0	1	2	3	4	5	10
Group 1: No evidence of fracture or dislocation								
None	47	44	2	1				
Slight	42	41	1					
Moderate	14	10	3	1				
Group 2. Fractures and/or dislocations C-3 through C-7								
None	35	33	1		1			
Slight	13	11	1		1			
Moderate	4	1	1	1	1			
Group 3. Fractures and/or dislocations of atlas and axis								
None	28	12	3	5	2	2	3	1
Slight	12	2	2	3	4	1		
Moderate	5	2		3				

strated in only 2 of our cases (Fig. 8). In the other 2 cases the only visible fractures involved the axis (Fig. 9). As in unilateral offset, it is almost certain that in the latter 2 cases there were hidden fractures of the atlas.

Fractures of the neural arch of the axis would appear to form a separate entity. In the majority of these cases, in spite of rather severe fractures, the relationship of the atlas to the axis was not disturbed (Fig. 10).

Amount of Offset: No definite correlation could be demonstrated between the amount of offset and the site of injury (Table III). There was a tendency, however, for the larger offsets, *i.e.*, 3 mm. or more, to occur more frequently in Group 3. This was particularly evident in the fractures and dislocations of the atlas and the odontoid process.

While it has been shown that rotation and abduction of the head can produce unilateral medial or bilateral offset, there was no evidence that the incidental failure

Fig. 9. Bilateral spread associated with a fracture through the base of the odontoid process and slight anterior dislocation. Though not visible on the conventional views, a hidden fracture of the arch of the atlas almost certainly was present.

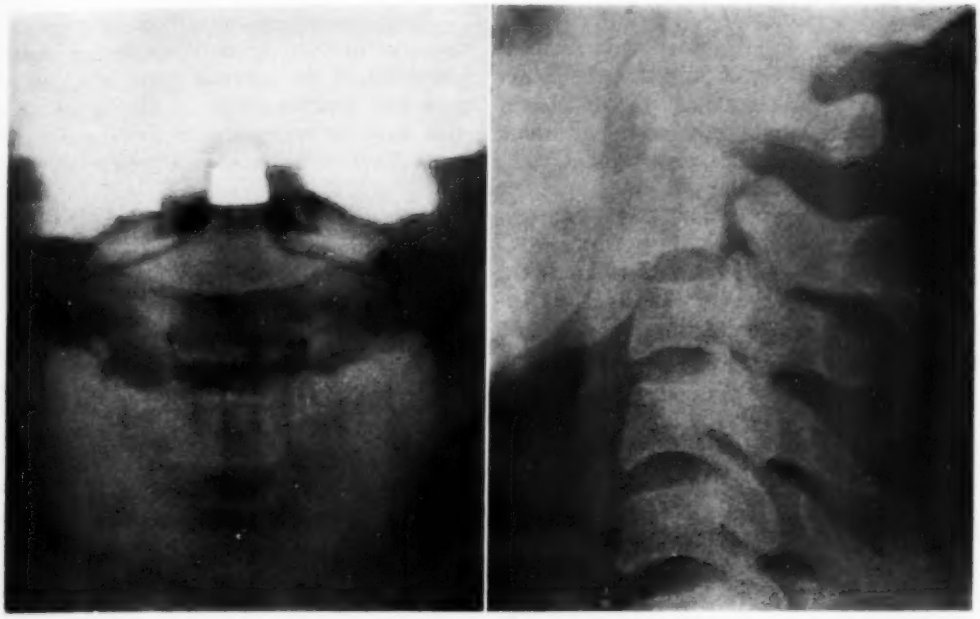

Fig. 10. Fracture through the pedicles of the axis without disturbance of the relationship of the articular surfaces of the axis and atlas.

to maintain the head in neutral position during the roentgen examination had more than slight influence on the amount of offset (Table IV).

SUMMARY

In an attempt to evaluate the significance of atlanto-axial displacement (offset) as seen in the anteroposterior roentgenogram, 200 consecutive patients suspected of cervical spine injury were studied.

The incidence of offset was 64.5 per cent in patients with fractures and/or dislocations of the atlas and axis, 13.5 per cent in patients with fractures and/or dislocations of the third through the seventh cervical vertebra, and 7.7 per cent in patients without other evidence of fracture or dislocation.

The following types of offset were recognized:

Unilateral medial offset occurred in 20 per cent of the cases of fracture and/or dislocation of the atlas and axis as compared to 6 per cent of the remainder of the cases.

Unilateral lateral offset occurred in 20 per cent of the cases of fracture and/or dislocation of the atlas and axis as compared to 1 per cent in the remainder of the cases.

Bilateral offset occurred in 15 per cent of the cases of fracture and/or dislocation of the atlas and axis as compared to 2 per cent of the remainder of the cases.

Bilateral spread occurred in 7 per cent of the cases of fracture and/or dislocation of the atlas and axis as compared to none in the remainder of the cases.

There was a tendency for the larger amounts of offset, 3 mm. or greater, to occur more frequently with fractures and dislocations of the atlas and odontoid process.

Rotation and abduction of the head as it occurred during roentgen examination did not appear to have a significant influence on the amount of offset.

CONCLUSIONS

The various types of lateral offset of the articular masses of the atlanto-axial joint

occur with significantly greater frequency in association with fractures and dislocations of the atlas and axis than in either fractures and dislocations of the lower cervical spine or in those cases in which there are none of the conventional signs of fracture or dislocation.

Since unilateral medial and bilateral offset can be produced by the normal movement of the atlas in relation to the axis, they are not necessarily the result of injury. It is suspected that some of the instances of unilateral medial and bilateral offset represent rotatory dislocations. However, bilateral spread can be produced only by fracture of the atlas, and it is highly probable that unilateral lateral offset is due to the same mechanism.

When an offset, regardless of type, is demonstrated on an anteroposterior roentgenogram of the cervical spine, meticulous roentgen examinations of the atlas and axis may be necessary to disclose an obscure fracture of these two vertebrae.

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SUMARIO

Justipreciación del Desplazamiento Atlanto-Axil de la Porción Cervical del Raquis

Tratando de apreciar la importancia del desplazamiento atlanto-axil que se observa en la radiografía anteroposterior, se estudió a 200 enfermos consecutivos en que se sospechaba la existencia de lesión de la porción cervical de la espina dorsal. Las varias formas de desplazamiento lateral de las masas articulares de la articulación atlanto-axil se presentaron con frecuencia significativamente mayor cuando había fracturas y luxaciones del atlas y del axis que cuando había ya fracturas o dislocaciones de la porción cervical inferior del raquis o que en los casos en que no existía ninguno de los signos característicos de fractura o dislocación.

Como el movimiento normal del atlas en relación con el axis puede producir desalineación unilateral hacia el medio y bilateral, no debe considerarse esto como forzosamento efecto de una lesión. Sospéchase que algunos de los casos de dicha desalineación representan dislocaciones rotatorias. Sin embargo, la dilatación bilateral (desplazamiento en sentidos opuestos) no puede ser producida más que por la fractura del atlas, y es sumamente probable que se deba al mismo mecanismo la desalineación unilateral.

Cuando se observa una desalineación, sea cual fuere su forma, en una radiografía anteroposterior de la porción cervical de la columna vertebral, tal vez se necesite un meticuloso examen roentgenológico del atlas y del axis para descubrir una fractura obscura de esas dos vértebras.

Jejunogastric Intussusception[1]

CARL P. WISOFF, M.D.[2]

GASTROJEJUNOSTOMY, alone or in combination with gastric resection, is occasionally followed by intussusception of the jejunum through the stoma into the stomach. Two such cases were encountered recently at the Cincinnati General Hospital and form the basis of the present report.

The first case of jejunogastric intussusception was reported by Bozzi (5) in 1914. This was lost in the literature and subsequent authors cited Steber as having made the initial report in 1917. There followed a number of single case reports, so that in 1933 Bettman and Baldwin (3) were able to summarize the clinical findings in 33 cases. In 1924, von Brunn (6) published the first roentgenogram of the condition. The radiological features were later clearly described by Ledoux-Lebard and Garcia-Calderon (26) and Gutmann and Jobin (20). Aleman (2), in 1948, found 70 cases reported in the literature and added 2 of his own. Over 100 cases have been recorded up to the present writing.

Four types of jejunogastric intussusception have been encountered (Fig. 1). Most common by far is intussusception of the efferent loop of the gastrojejunostomy. Intussusceptions of the afferent loop and of both the afferent and efferent loops occur less often and are of about equal frequency. In Aleman's series the incidence was 74, 10, and 15 per cent, respectively. At least 7 cases of intussusception following subtotal gastrectomy have been reported (2, 18, 25, 29, 44, 45).

Clinical symptoms and signs are either of the acute or chronic type. In the acute form, which is much more frequently reported, there is usually colicky abdominal pain, nausea, and vomiting of bile-stained material. If the bowel remains incarcerated and becomes gangrenous, the vomitus usually becomes bloody. In 19 of the 70 cases reviewed by Aleman, an epigastric mass was palpable. A mistaken diagnosis of mechanical bowel obstruction or bleeding ulcer is usually made. In such cases, if medical management is instituted, the patient's life is jeopardized, the mortality then approaching 100 per cent.

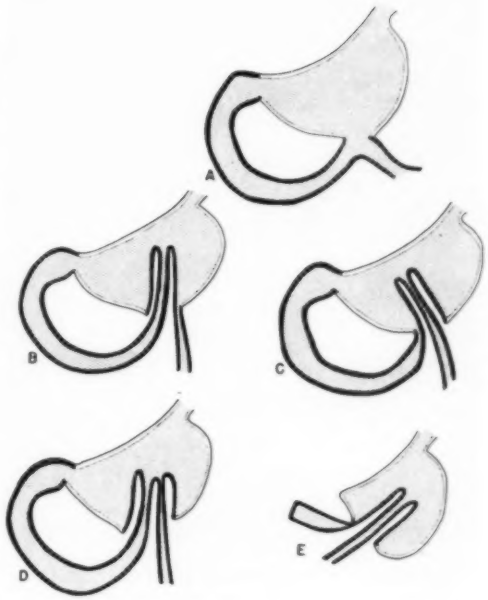

Fig. 1. Diagrammatic representation of the four types of jejunogastric intussusception. A. Normal gastrojejunostomy. B. Afferent loop intussusception. C. Efferent loop intussusception. D. Combined loop intussusception. E. Retrograde intussusception following gastrectomy.

In the chronic type, periodic attacks of abdominal pain, nausea, and vomiting may occur over a period of years. The symptomatology varies depending upon

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Fig. 2. Case I. Jejunogastric intussusception. The arrow indicates intussusception hidden in barium.

the degree of obstruction and, according to some authors (20), upon whether the afferent or efferent loop is involved. The correct diagnosis is rarely made clinically.

The diagnosis is based on the roentgen findings. A circumscribed intraluminal defect in the stomach, the outer surface of which shows the concentric striations of valvulae conniventes, in a patient who has had a gastroenterostomy is pathognomonic. The appearance of the filling defect varies with the length of the protruding intestinal segment, the amount of barium given, and the degree of pressure made when taking spot films. The size varies from a slight bulge into the lumen from the greater curvature at the site of the stoma to the presence of numerous coils filling the entire stomach. The valvulae conniventes may appear as parallel curves, fan-shaped lines, or spirals, depending on the angle at which they are viewed. The filling defect and folds may not be demonstrable unless compression is applied. If the pressure is too great, the mucosal pattern of the jejunum may be obliterated. Other findings which may also be present include dilatation of the stomach and/or the afferent loop due to obstruction at the stoma, flattening or cranial convexity of the greater curvature of the stomach, and displacement of the gastric antrum toward the right.

There is no widely accepted explanation of the cause of the intussusception. The condition may occur as early as six days after operation (28), although most cases follow a lapse of years. The length of the intussuscipiens ranges from 4 to 300 cm. (3, 22). The size of the stoma varies greatly from case to case. In none of the reported cases was there ulceration or tumor. Hyperacidity and irritation, which are often mentioned as factors in the production of jejunogastric intussusception, should not obtain in the gastrectomy cases.

CASE REPORTS

CASE I: H. J., a 49-year-old white woman, was first admitted to the Cincinnati General Hospital on Aug. 7, 1937, because of severe abdominal pain. The day before admission, while taking a bath, she was suddenly seized with severe knife-like epigastric pain, followed by repeated vomiting. The pain later radiated through to the back. There had been no hematemesis or tarry stools. A past history of attacks of epigastric pain every few months since 1932 was elicited. At that time a gastroenterostomy had been performed for "stomach ulcers."

On physical examination, marked epigastric tenderness and guarding were noted. A gastrointestinal series, Aug. 31, 1937, showed a normal stomach, duodenum, and gastroenterostomy stoma.

The patient responded well to bed rest and sedation and was discharged to the clinic. During the next fourteen years she continued to have periodic attacks of abdominal pain.

A gastrointestinal series was performed again on May 14, 1951. At the beginning of the examination, the barium flowed through the posterior gastroenterostomy stoma into the jejunum and no abnormalities were encountered. On further filling with barium, a loop of small bowel was seen to invaginate into the lumen of the stomach, partially blocking egress of the medium through the stoma. The gastric antrum distal to the stoma was slightly narrowed but showed a normal mucosal pattern. To

ward the end of the examination there was spontaneous reduction of the intussusception, and the barium again flowed freely into the duodenum and jejunum (Figs. 2 and 3).

On May 21, 1951, a repeat study showed essentially the same findings. This time the intussusception appeared as the first swallow of barium entered the stomach. The invagination spontaneously reduced, but reappeared after another swallow of barium. After a second spontaneous reduction, additional attempts to induce it failed.

Gastroscopy performed one month later showed jejunal mucosa in the stomach presenting a mushroom-like appearance. There was no evidence of ulcer.

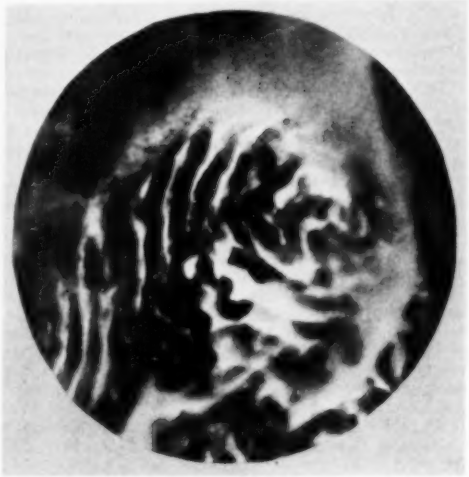

Fig. 3. Case I. Pressure spot film showing the filling defect and the characteristic jejunal mucosal pattern.

At operation, performed on July 9, 1951, the gastrojejunostomy was found to be twisted, and the afferent loop invaginated into the stomach for an unspecified distance. A subtotal Billroth gastric resection and jejunal anastomosis were performed. Pathologic examination revealed marked congestion of the jejunum and chronic gastritis.

The follow-up gastrointestinal series showed a normally functioning stoma, but the patient has continued to have occasional abdominal pain.

CASE II: J. J., a 34-year-old colored female, was admitted to the Cincinnati General Hospital on Feb. 11, 1951, complaining of abdominal pain. Six days prior to admission she experienced aching pain in the right upper quadrant shortly after eating. The pain soon became more severe, radiating to the subscapular region and to the left chest. It was worse in the supine position and was not relieved by antacids. Intake of food was said to bring on the discomfort. There had been no nausea or vomiting.

Fig. 4. Case II. Jejunogastric intussusception. The arrow indicates filling defect in stomach.

A gastroenterostomy performed for duodenal ulcer nine years earlier had resulted in relief of ulcer symptoms for five years, but periodic epigastric pain, relieved by food, then recurred. Physical examination showed normal findings.

Gastrointestinal series performed on two occasions, Jan. 15, 1951, and Feb. 15, 1951, revealed a normally functioning stoma and no evidence of ulcer. A cholecystogram showed normal findings.

While in the hospital, the patient had one attack of right upper quadrant pain simulating gallbladder colic. Following her discharge, she continued to have attacks of pain.

A gastrointestinal series was repeated on Oct. 13, 1951 (Figs. 4 and 5). At that time a filling defect in the stomach in the region of the gastroenterostomy was found, and the stomach failed to empty. Pressure over the defect produced a pattern of multiple concentric spirals (valvulae conniventes). After considerable manipulation, the filling defect disappeared, and emptying of the stomach proceeded through the gastroenterostomy stoma in a normal manner. At this point, the patient stated that her pain was less severe. There was no evidence of marginal ulcer. A diagnosis of intermittent jejunogastric intussusception was made.

Gastroscopy was performed July 8, 1952, but was

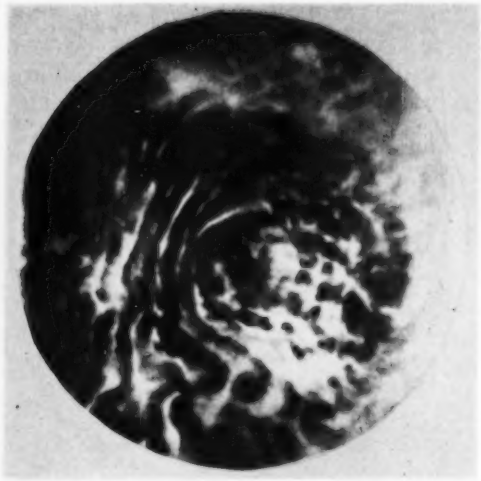

Fig. 5. Case II. Pressure spot film showing the filling defect and the characteristic jejunal mucosal pattern.

unsatisfactory. The patient continues to have episodes of epigastric pain and occasionally nausea and vomiting.

SUMMARY AND CONCLUSIONS

Two cases of jejunogastric intussusception following gastroenterostomy are added to the more than one hundred cases which have been reported in the literature. Symptoms may be either of the acute or chronic type, depending on the degree and reducibility of the obstruction. The acute form is usually fatal if the condition goes unrecognized. A clinical diagnosis of jejunogastric intussusception is rarely made, but the roentgen findings are pathognomonic. Surgical treatment usually relieves the symptoms and may be life-saving in the acute cases.

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SUMARIO

Invaginación Gastroyeyunal

Agregánse aquí 2 casos de intususcepción yeyunogástrica consecutiva a la gastroenterostomía a los más de 100 casos que ya constan en la literatura. Los síntomas pueden tomar forma ya aguda o crónica, conforme a la intensidad y la reducibilidad de la oclusión. La forma aguda suele resultar letal si no se reconoce la lesión.

El diagnóstico de invaginación gastroyeyunal rara vez se hace clínicamente, pero los hallazgos roentgenológicos son patognomónicos: un defecto intraluminal circunscrito en el estómago, cuya cara externa revela las estrías concéntricas de las válvulas conniventes.

El tratamiento quirúrgico suele aliviar los síntomas y puede salvar la vida en los casos agudos.

Pyloric Antral Mucosal Diaphragm

Report of a Case[1]

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THE OCCURRENCE of a hymen-like ring of mucosa, muscularis mucosae, and submucosa causing partial obstruction within the stomach appears to be exceedingly rare, and it is for this reason that the following case is being reported.

R. C., a 35-year-old woman, was first seen on Jan. 12, 1951, complaining of intermittent vomiting of several years duration, aggravated by solid food, and partially relieved by a liquid diet. She experienced a sensation of fullness in the upper abdomen, but no pain.

The patient had been married for fourteen years and had three children living and well. Because of symptoms similar to those of which she now complained, an appendectomy and four pelvic operations, including bilateral salpingo-oophorectomy and total hysterectomy, had been performed without producing relief.

The physical examination revealed no significant pathological change. The abdominal examination was entirely non-contributory; no abdominal mass, tenderness, or rigidity was present. The liver and spleen were not palpable.

Urinalysis was normal. The red blood cell count was 4,750,000; white cell count 6,000; hemoglobin 14 gm. 95 per cent.

X-ray examination following a barium meal showed the stomach to be normal down to the gastric antrum, approximately 3 cm. beyond the angularis. There a persistent linear defect with sharp margins was demonstrable in all possible projections and regardless of the position of the patient (Fig. 1). The barium passed by this partial occlusion without significant delay, showing the prepyloric antrum, pylorus, duodenal bulb, and duodenal loop to be entirely normal, with no evidence of pathological change of the small bowel. The exact nature of the diaphragm-like process could not be determined at this time. A second examination revealed exactly similar findings (Fig. 2).

Operation was performed chiefly because of the persistent symptoms. Under endotracheal anesthesia a right paramedian incision was made through the moderately thick abdominal wall. Upon opening the peritoneum, exploration revealed dense adhesions in the pelvis from previous laparotomies. The large and small bowel were negative to palpation. The gallbladder was thin-walled, without stones, and emptied with pressure. The liver edge was sharp, and the liver was normal in consistency. The kidneys were normal in size, shape, and position. The gastrocolic ligament was opened and the pancreas found to be normal throughout. The stomach appeared normal. The duodenum was mobile, without evidence of previous disease. It was opened, and 2 cm. above the pylorus there was demonstrated a thin structure 2 to 3 mm. in thickness, with a small stellate perforation 3 to 4 mm. in diameter. The opening in the membrane was situated slightly off-center, so that pressure of the latter against the pylorus closed both openings (Fig. 3). A Finney pyloroplasty was accomplished, including the membrane in the anastomosis, the latter being incised to the opening. On completion this gave a wide-open anastomosis. The abdomen was closed in layers.

DISCUSSION

In a rather extensive search of the literature only one similar case could be found (1). In that instance a gastric ulcer was present and a subtotal gastrectomy was done, allowing a somewhat better histologic evaluation of the process. An incidental description of what sounds like a similar process is included in a report of a case in a paper describing gastroduodenal ulceration in the newborn. This description was based on the postmortem study; there were no roentgenographic findings premortem (2). The standard texts on the roentgen examination of the gastrointestinal tract (3, 4, 5, 6) and innumerable descriptions of the gastric antrum make no mention of this entity, though the occurrence of webs, diaphragms, or congenital atresias, both partial and complete, has frequently been described elsewhere in the intestinal tract. Atresias have been seen in the esophagus, duodenum, and small and large intestine (7, 8), some of them in adults, in whom they presumably have been present since birth, and some producing symptoms suggestive of inter-

[1] Accepted for publication in October 1952.

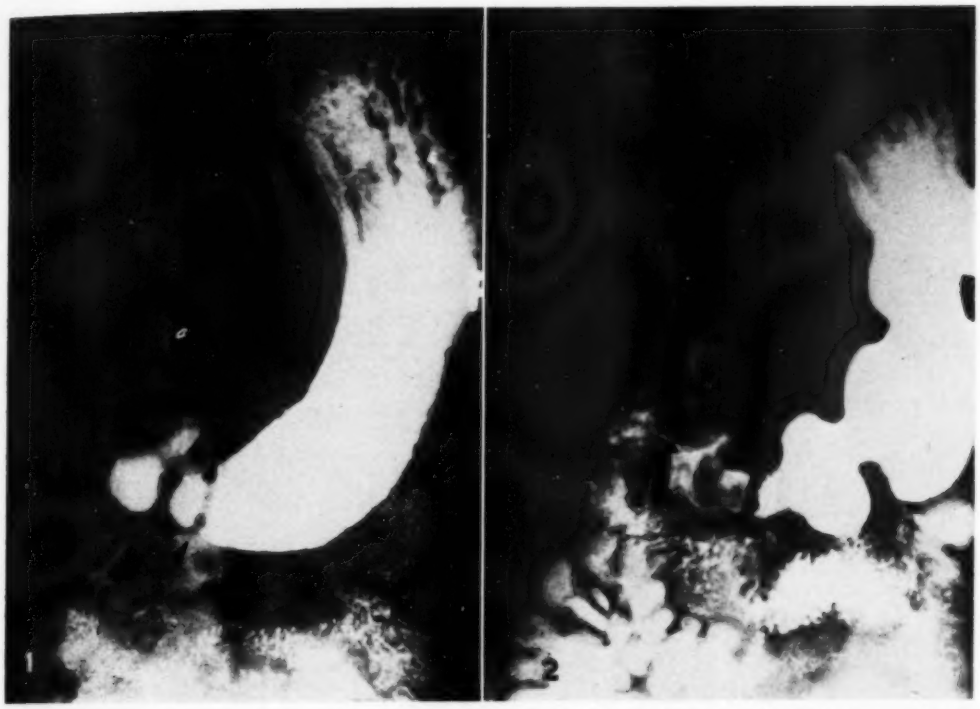

Fig. 1. The membrane in the prepyloric segment of the stomach is clearly demonstrated with its lumen slightly dilated at the time of the first examination.
Fig. 2. Repeat examination again shows the gastric diaphragm causing no evidence of obstruction to the passage of liquid barium.

mittent obstruction from an early age (9).

It is believed that the hymen-like diaphragm in this case must be considered of congenital origin (10). The genetic etiology for such a condition is largely hypothetical. There appears, however, to be a close association and integration between sex and stature factors and the visceral developmental pattern (11).

The embryological considerations are worthy of some discussion, for presumably the origin of the deformity is at this stage of development. The esophagus, stomach, and intestine in the 5-mm. stage are discernible, the stomach being a dilatation of the foregut. At the 7 to 9 mm. stage, however, the esophagus and duodenum are practically solid for a brief period. This transitory atretic condition of the esophagus is presumed to be a device for protection of the developing lung against

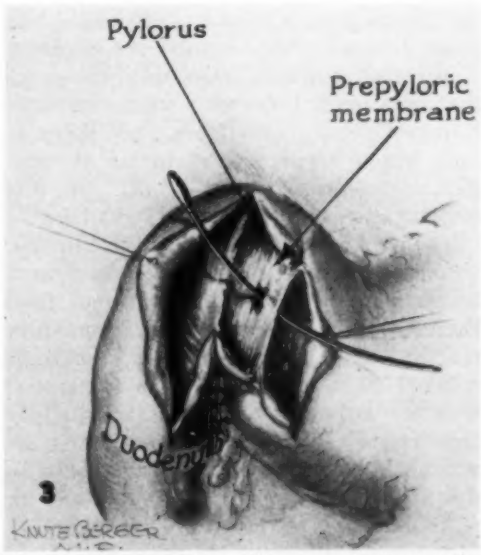

Fig. 3. The prepyloric membrane as visualized at the time of operation with a probe through its hiatus.

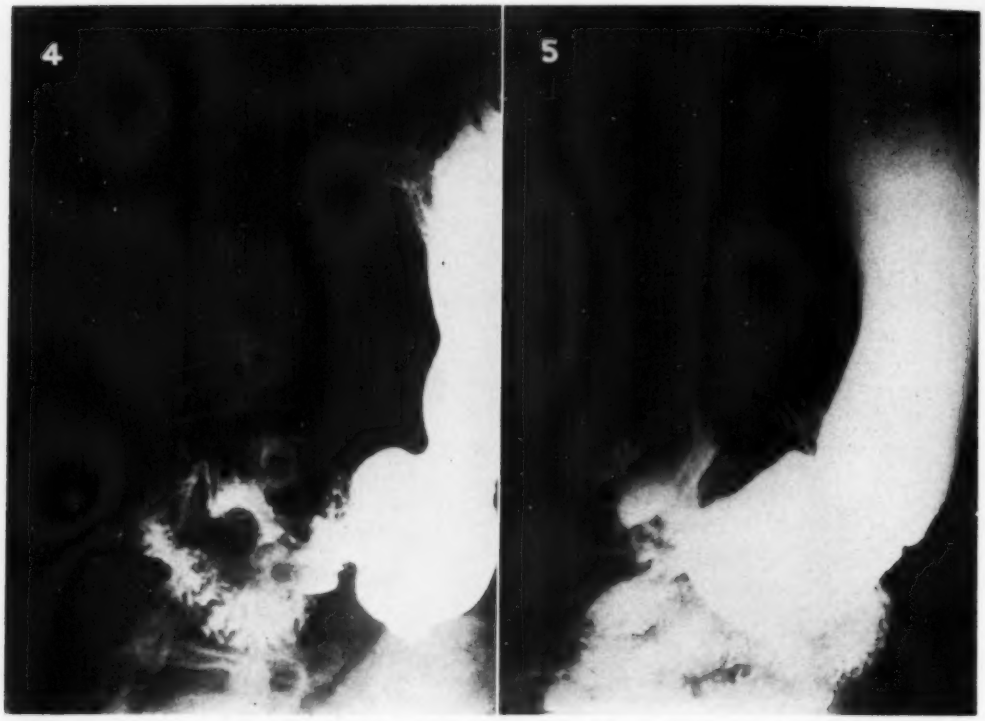

Fig. 4. The roentgen appearance of the stomach, pylorus, and duodenum one and one-half months after surgery.
Fig. 5. Postoperative appearance at fifteen months, with the patient completely asymptomatic.

the yolk escaping from the yolk sac through the developing intestine. Although this phase does not always involve the stomach, it becomes apparent that in some cases that organ also becomes a solid structure. Embryologically, therefore, the present case would seem to be similar to congenital stenosis and atresia of the esophagus and duodenum (12, 13).

The possibility of such a partially obstructing diaphragm being acquired must be considered. In some esophageal cases there has been evidence of an inflammatory reaction with fibrosis (14), and by some authors Plummer-Vinson's syndrome and web formation have been attributed to this factor (15). In our patient there was no hypochromic microcytic anemia or dysphagia.

Redundancy of the gastric mucosa (16), extragastric adhesions (17), hypertrophy of the annular musculature in the pyloric antrum (18, 19), cicatricial scarring resulting from old healed gastric ulcer with contracture of the mucosa and submucosa (20), ectopic smooth muscle in the gastric mucosa (21), large rugal folds otherwise normal (22), and, though more remotely, heterotopic pancreatic tissue in the region of the pyloric orifice (23, 24) or even pure spasm of the musculature (25, 26), could conceivably be confused (27, 28) with this lesion on roentgen examination and are worthy of consideration in the differential diagnosis.

It is of some interest to consider the fact that this partially occluding membranous diaphragm had been present for some thirty-five years without producing notable symptoms of obstruction previous to this time, and that, so far as could be told by the use of liquids in the examination of the stomach, it still caused no demonstrable obstruction, although obstructive symp-

toms occurred after meals. The barium reaching the abnormal membrane was apparently motivated through its foramen by peristaltic waves and the other factors of gastric motility (29). On no examination, however, did it disappear or move significantly in relation to the barium-filled portion of the stomach, as one might expect from experimental and clinical studies of gastric motility (29, 30).

The absence of obstructive symptoms may be explained by the presence in the diaphragm of a foramen comparable in size to the pyloric orifice, for there is no physiologic requirement for a passage larger than this, once foods are liquefied by gastric digestion. Nevertheless, the fact that symptoms were immediately improved postoperatively and have remained absent for the ensuing year and a half would seem to justify the surgical intervention, despite the fact that no true obstruction could be demonstrated by conventional roentgenologic methods before or after operation (Figs. 4 and 5), though with the abdomen open manual pressure above the diaphragm caused it to obstruct the pyloric orifice.

SUMMARY

A case of partial gastric atresia due to a mucosal diaphragm, probably of congenital origin, is reported, producing no evidence of obstruction on roentgen examination. Persistent vomiting led to surgical intervention, with postoperative improvement.

A review of the literature revealed only one similar case.

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SUMARIO

Diafragma Mucoso del Antro Pilórico: Presentación de un Caso

El caso descrito es de atresia parcial producida por un diafragma mucoso, probablemente congénito. Aunque el mismo había estado presente presuntamente unos 35 años, no había provocado mayores signos de obstrucción, debido probablemente a la existencia en aquél de un agujero de tamaño comparable al del orificio pilórico.

El examen roentgenológico reveló un defecto lineal constante de bordes agudos, unos 3 cm. más allá de la angular, pero el bario atravesaba esa oclusión parcial sin mayor demora. La operación, ejecutada en gran parte por virtud de los persistentes episodios de vómitos, reveló la presencia de la membrana obstructora y de la abertura estrellada. Se llevó a cabo una piloroplastia, obteniéndose una anastomosis bien abierta, con alivio de los síntomas.

Un estudio de la literatura no reveló más que un caso semejante.

Roentgenographically Characteristic Adenocarcinoma and Leiomyosarcoma in the Same Stomach[1]

CHRISTIAN V. CIMMINO, M.D.[2]

THIS REPORT concerns a patient found to have two synchronous malignant neoplasms of the stomach, an adenocarcinoma and a leiomyosarcoma.

An extensive literature (1, 2) on multiple cancer, non-radiologic for the most part, has accumulated over the years since Billroth described the first case in the last century. It is no longer an isolated phenomenon, and progressively more cases are to be expected because of our aging population. With this in mind, the physician should guard against routinely ascribing all the findings in a patient to a single tumor, or to a recurrence or metastasis of a former tumor, and consider the possibility of multiplicity.

The subject of multiple tumors is, and will continue to be, of major interest, apart from its curio value, until the problems of pathogenesis of malignant tissue have been solved. Multiplicity of cancers, synchronous and metachronous, in one and several organs, of similar and dissimilar cell types, has been studied exhaustively by Warren and Gates (1) historically and statistically. Their paper is a storehouse of information. Occasional cases of gastric carcinoma associated with lymphosarcoma or "sarcoma," and of multiple gastric leiomyosarcoma are mentioned, but none of gastric carcinoma and leiomyosarcoma, although at least 4 examples of this latter combination are reported in the uterus. Since the stomach and the uterus are alike in their affinity for smooth muscle tumors and carcinomas, it is possible that the combination of carcinoma and leiomyosarcoma in the stomach is not so rare as the figures indicate.

Statistics are fraught with possible error because of the difficulty in defining and applying the criteria for multiplicity, the incomplete study of all tissues at autopsy, and the inadequate reporting of cases. Most authors feel, however, that multiple cancers occur more often than can be explained on the basis of chance. For example, in one series, multiple cancers were found in 3.7 per cent of 1,078 autopsies of cancer patients (1). This was explained by a "predisposition or susceptibility to cancer in certain persons, or the action of some factor favoring the development of malignancy." Ewing (3), however, doubted the validity of any conclusions based on such statistics because of the uncertainty that all cases included therein represent true multiplicity.

The consensus is that even solitary gastric leiomyosarcoma is a rare tumor. According to Feldman (4), it comprises about 1 per cent of all malignant gastric neoplasms. This is not in accord with our experience. Three gastric leiomyosarcomas, studied by competent pathologists, have passed through the radiology department of the small community hospital from which this report comes within the last four years. Schindler *et al.* (5) observed 4 cases within a relatively short time and stated that the statistics of incidence must be misleading. The discrepancy may be related in part to the difficulty in histologic diagnosis of these mesodermal tumors, especially the differentiation between smooth muscle tumors and tumors of neural origin, not only as to the cell of origin but also as to their malignancy or benignancy.

The relatively low incidence of gastric leiomyosarcoma is in marked contrast to the high incidence of its benign counterpart. Careful study of the stomachs from 50 routine autopsies disclosed asymptomatic small spindle-cell tumors in 46 per cent, most of these being considered leio-

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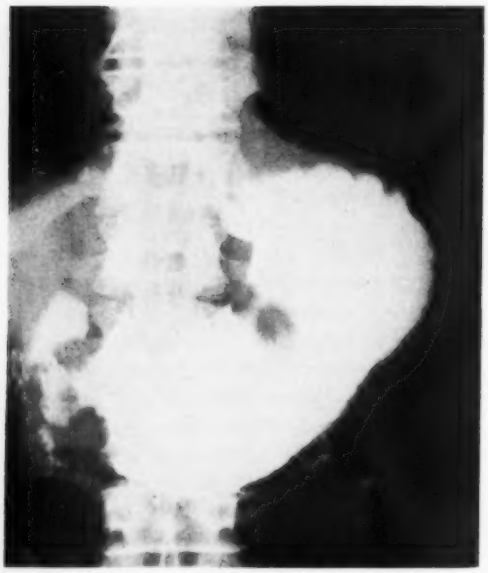

Fig. 1. Radiographically characteristic carcinoma tally; intramural extramucosal tumor proximally.

myomas, though a few may have been neurofibromas (6). Rieniets (7) found 43 leiomyomas in 32 stomachs from 200 autopsies. If these figures be correct, the relatively low incidence of leiomyosarcoma would indicate that malignant change in the common gastric leiomyoma is a rare event, or that it does not occur at all, the malignant form arising *de novo*.

G. P., a 68-year-old Negro male, was admitted to the hospital with an eight-year history of intermittent pains in the epigastrium. The pains were cramping, usually post-prandial, and had been somewhat relieved over the years by symptomatic therapy. For the past three months, they had increased and become associated with vomiting occurring about an hour after meals. Tarry stools had been noted, but no hematemesis. The appearance on physical examination indicated chronic illness, dehydration, and hypertension. The hemoglobin was 4.4 gm. per cent. A subtotal gastrectomy was done by Dr. John L. Smoot.

The stomach was studied by members of the Department of Pathology at the University of Virginia, whose report (abstracted) follows: "A study of sections through the tumor near the pylorus reveals a fairly typical adenocarcinoma.... A study of the second intramural extramucosal tumor revealed this to be made up, for the most part, of oval and spindle-shaped cells varying tremendously in size and configuration, many being round or oval or polyhedral, with rather large vesicular nuclei, while others are more spindle shaped, again quite large, with giant forms.... There is no evidence of continuity seen in the tumors; they are completely dissimilar in patterns of growth, and there is no reason to feel they are related, except by coincidence.

"*Diagnosis:* Adenocarcinoma of stomach, Grade 2. Leiomyosarcoma."

Dr. F. W. Foote, Jr., of Memorial Hospital, New York, studied the sections and concurred in the diagnosis.

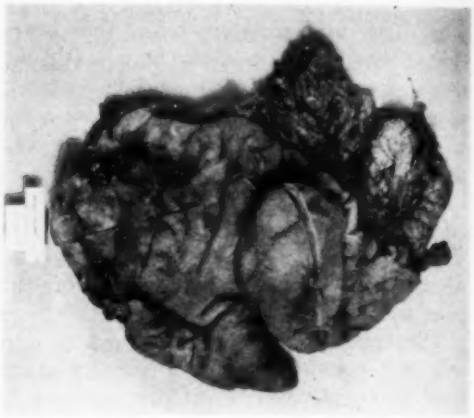

Fig. 2. Gross specimen: the adenocarcinoma is to the left, and the leiomyosarcoma to the right. Sections taken between these two tumors showed normal stomach.

The roentgenograms, illustrated by Figure 1, were typical of carcinoma in the distal end of the stomach and of an intramural extramucosal tumor proximally, in accordance with the criteria for the diagnosis of such tumors as laid down by Schatzki (8) and others (9). Lowman *et al.* (10) have demonstrated that such criteria are not pathognomonic of intramural extramucosal tumors but may be present with mucosal tumors as well. This consideration, plus statistical probability, led to the preoperative roentgen diagnosis of a single malignant tumor, probably adenocarcinoma.

SUMMARY

A case is presented of radiographically characteristic but not pathognomonic leiomyosarcoma and adenocarcinoma of the stomach, occurring coincidentally. Attention is directed to the fact that multiplicity of cancers is a real possibility.

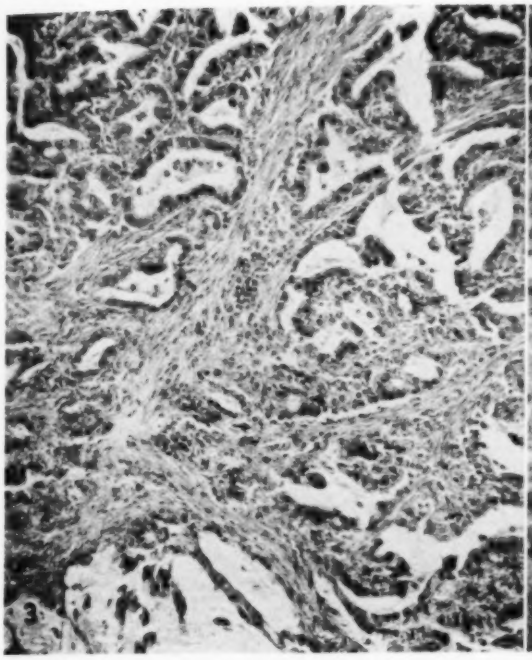

Fig. 3. Adenocarcinoma.

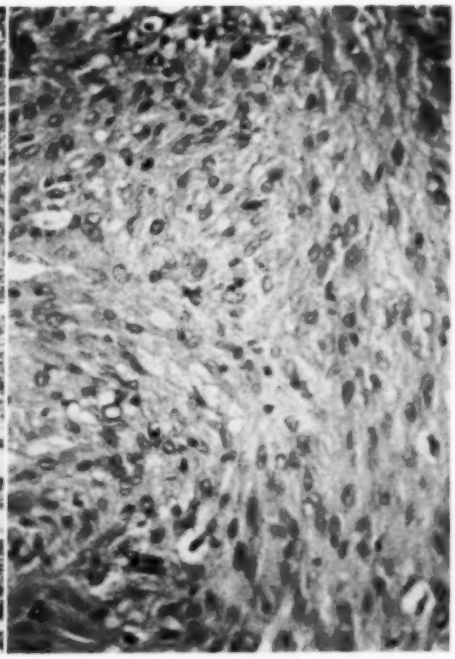

Fig. 4. Leiomyosarcoma.

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SUMARIO

Adenocarcinoma y Leyomiosarcoma Roentgenológicamente Tipicos en el Mismo Estómago

El caso presentado es de coexistencia de leyomiosarcoma y adenocarcinoma del estómago, radiográficamente típicos, pero no patognomónicos. Las radiografías eran típicas de carcinoma en el estremo distal del estómago y de tumor extramucoso proximalmente. El diagnóstico preoperatorio fué de tumor maligno solitario.

El cáncer múltiple ya no constituye un fenómeno aislado, y cabe esperar cada vez más casos a medida que va envejeciendo la población. Teniendo esto presente, el médico debe estar sobre aviso para no imputar sistemáticamente todos los hallazgos en un enfermo a un solo tumor o a recurrencia o metástasis de un tumor anterior, debiendo considerar la posible multiplicidad.

Situs Inversus of Stomach[1]

MAX A. ALMY, M.D., FRED H. VOLK, M.D., and CHARLES M. GRANEY, M.D.
Batavia, N. Y.

COMPLETE TRANSPOSITION of the viscera, or situs inversus totalis, in which the thoracic and abdominal viscera occupy a position the reverse of normal, occurs about once in 6,000 to 8,000 individuals. The common use of x-ray and physical examinations for the Army, schools, and industry have uncovered many cases and have established this incidence as reasonably accurate.

Of considerably less frequent occurrence than situs inversus totalis is situs inversus partialis, involving a single viscus. Dextrocardia is the most common example of partial situs inversus. Of the abdominal organs, that portion of the intestinal tract which develops from the midgut is chiefly involved, for the foregut and hindgut are considered to be more stable and fixed in their positions. Dott (6) states that "error in location or attachment of the foregut situated within the abdomen (stomach and duodenum down to the biliary papilla) is excessively rare." The present report concerns a case of inversion of the stomach alone.

The majority of cases of right-sided stomach are associated with eventration of the diaphragm and are reported as being confused with spontaneous hydropneumothorax or pyopneumothroax at the base of the right lung. Among cases in this category are those of Giffin (4), Kinney (5), Harris and Stivelman (9), Greenwald and Kaufman (10), Kinzer and Cook (17), and Nayer (21).

In our case the diaphragm was normal. The liver and gallbladder were in normal position, and the stomach lay to the side and posterior to the right lobe of the liver. This appears to correspond to cases reported by Risel (2 and 3), Buis (7), Rosselet and Mengis (11) and, more recently, by Anton, Panoff, and Spiegel (15).

Fig. 1. Roentgenogram obtained Nov. 5, 1951. Three-hour film after ingestion of barium, showing disposition of stomach and duodenum in inverse position.

Good discussions of the embryology of visceral transposition can be found in papers by Dott (6), Cockayne (13), and Anton, Panoff, and Spiegel (15). There are several etiologic theories, none of which appears to explain the phenomenon fully. In a medial sagittal plane, the human embryo of a few millimeters presents two sides which are mirror images of each other. As a result of an altered relationship between the embryo and chorion, or an abnormal development of the omphalomesenteric artery, or environmental influences on the ovum, embryonic development proceeds asymmetrically.

In this instance the right-sided stomach was discovered during a cholecystectomy and later confirmed radiographically.

[1] From Genesee Memorial Hospital, Batavia, N. Y. Accepted for publication in October 1952.

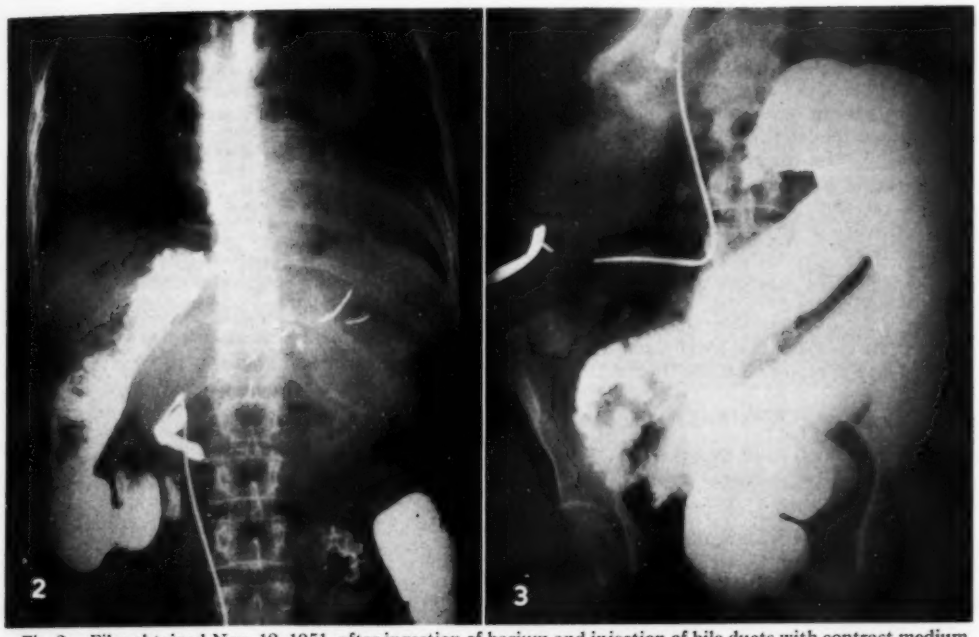

Fig. 2. Film obtained Nov. 12, 1951, after ingestion of barium and injection of bile ducts with contrast medium, showing right-sided stomach, right-sided common duct, and heart in normal position in left side of thorax.
Fig. 3. Barium-enema study of Nov. 11, 1951, showing relatively normal disposition of large intestine.

A white female of fifty-six years was admitted to Genesee Memorial Hospital on Oct. 4, 1951, for a cholecystectomy, the diagnosis of cholelithiasis having been confirmed by a gallbladder x-ray series on May 14, 1951. At that time she had complained of repeated attacks of upper abdominal pain and intolerance to fatty foods. She gave a history of having had a cholecystostomy for acute cholecystitis about ten years previously and about six years previously had had a vaginal hysterectomy. Following demonstration of multiple calculi of various sizes, medical treatment was instituted without much improvement. Cholecystectomy was performed on Oct. 6, at which time stones were also removed from the common duct, in which a T-tube was placed. At the close of the operation, which was made more difficult because of adhesions from the previous operation, a structure was noticed in the right flank which gave the appearance of stomach. Further exploration was not carried on at this time, but on Nov. 5 a gastrointestinal series was done for the purpose of visualizing the stomach. This showed the lower extremity of the esophagus crossing to the right, with the stomach on the right side of the abdomen in an exact reversal of its normal position. It was of a fishhook type and fairly long but in a relatively high position. Coarse rugal markings were present, but there was no filling defect or intrinsic gastric lesion. The pylorus was smooth and regular. The duodenum functioned without delay, and the cap filled satisfactorily.

Fig. 4. Artist's conception of disposition of organs, based on description and multiple roentgenograms.

On Nov. 12, further roentgen studies showed the heart in the left side of the chest and again demon-

strated the stomach in the right side of the abdomen. At this time the T-tube was filled with contrast medium and showed the common bile duct to lie on the right side of the abdomen. The colon was filled with barium by enema, and it was shown to lie mostly on the left; the sigmoid and descending colon were on the left and the cecum in the right side of the abdomen. An electrocardiogram was obtained on Nov. 10 for the purpose of showing the polarization of the heart, and was reported as being normal.

The patient made a good recovery from her operative procedure and was told about the abnormal position of the stomach. She has been seen at regular intervals of about one month and is free from any digestive disturbance at the time of this report.

SUMMARY

A case of an extremely rare developmental anomaly has been reported, namely, situs inversus of the stomach with the other viscera in a normal position. The reader is referred to other sources for an embryologic discussion of the condition.

The existence of this anomaly was discovered at cholecystectomy and later confirmed by repeated x-ray studies.

Because of its rarity, it would seem that right-sided stomach without total inversion of the viscera is of little clinical significance.

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SUMARIO

Situs Inversus del Estómago

Preséntase un caso de una anomalía sumamente rara del desarrollo, a saber, situs inversus del estómago con las demás vísceras en su posición normal. El estómago fué descubierto en el lado derecho durante una colecistectomía, confirmándose el hecho después con repetidos estudios roentgenográficos.

Por virtud de su rareza, parece que el estómago en el lado derecho sin inversión de las demás vísceras posee poca importancia clínica.

Radiographic Demonstration of Localized Mesenteric Thrombosis

A Case Report[1]

HUGH A. CREGG, M.D., and FREDERICK GOETHE SMITH, M.D.

MESENTERIC thrombosis is rarely diagnosed correctly prior to surgery or autopsy. The case to be presented is unique in that a second episode of localized mesenteric thrombosis occurred nine days following resection of an acutely infarcted segment of ileum. Preoperative roentgen examination at the time of this second thrombosis clearly demonstrated the infarcted loop of ileum, thus establishing the diagnosis, which was confirmed by operation.

Fig. 1. Anteroposterior supine view of abdomen.

Fig. 2. Postero-anterior upright view of abdomen.

CASE REPORT

A 65-year-old man was admitted to the Marion City Hospital twelve hours after the onset of abdominal pain. The pain was continuous, gradually increasing in severity, shifting its position from the right upper abdomen in the recumbent position to the right lower abdomen in the erect. There was no nausea or vomiting. The patient had been obese and hypertensive for many years, and for several years had shown persistent auricular fibrillation and severe obliterative arteriosclerotic disease of both lower extremities.

The patient was acutely ill; the temperature was 99.2°, the pulse 96, and the respirations 24. The heart tones were of good quality, totally irregular, and the blood pressure was 140/70 mm. Hg. The abdomen was very protuberant. There were a small umbilical hernia and a left inguinal herniorrhaphy scar. The right lower quadrant was quite tender, with slight rebound tenderness and moderate muscular defense. In the right upper quadrant a distinct mass was palpable, which was thought to be the liver edge. Peristaltic sounds were

[1] From the Departments of Radiology and Surgery of the Frederick C. Smith Clinic, Marion, Ohio. Accepted for publication in October 1952.

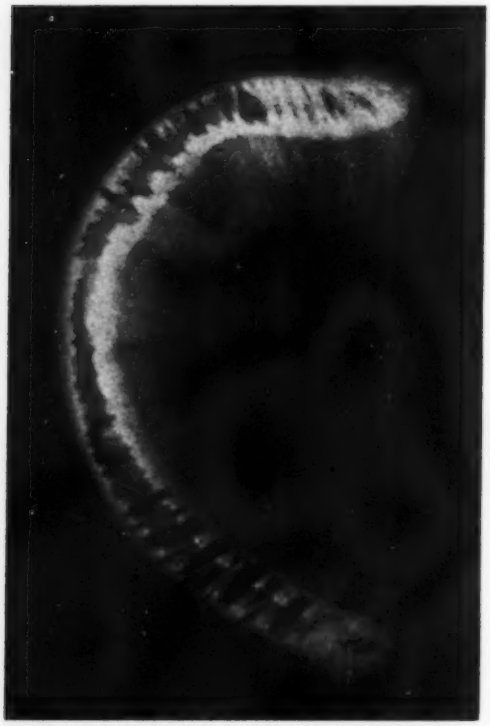

Fig. 3. Roentgenogram of resected specimen.

slightly over-active without associated cramping pain. The hemoglobin was 113 per cent, erythrocytes 5,430,000, leukocytes 11,050, with neutrophils 90 per cent. No x-ray studies were made. Acute appendicitis was considered the most likely diagnosis.

Celiotomy showed a blackened loop of ileum 30 cm. in length lying at the level of the umbilicus on the right side. The bowel wall and the mesentery were much thickened by hemorrhage and edema, thus producing the mass which had been thought preoperatively to be the liver edge. This segment, together with 15 cm. of viable bowel at either end, was resected, and an open end-to-end anastomosis was performed. The pathological diagnosis (Dr. Horace B. Davidson, Columbus, Ohio) was hemorrhagic infarction of the bowel and thrombosis of the mesenteric vein.

The postoperative course was satisfactory, with continuous gastric suction and antibiotics. Three days after operation, administration of heparin (Depoheparin) was started, and prolongation of clotting time was maintained for four days. The patient was discharged feeling quite well eight days after operation.

On the day following his discharge from the hospital, the patient was readmitted with recurrent abdominal pain of twelve hours duration. There was moderate tenderness in the right upper quadrant and bowel sounds were very active.

Radiological examination of the abdomen in the anteroposterior, supine, and postero-anterior erect positions showed absence of air in the intestinal tract with the exception of one small bowel loop, in which the mucosal pattern could be seen and the outer surface of the thickened wall was visible. The thickness of the bowel wall here was approximately 1.0 cm. A large mass of uncertain character beneath this loop displaced the colon laterally to the right. There was no evidence of any mechanical obstruction or hyperdynamic dilatation. Recurrent mesenteric thrombosis seemed highly probable in view of the previous history and the localized thickening of the bowel wall (Figs. 1 and 2).

Operation was performed on the day of readmission. An infarcted segment of ileum was found 30 cm. above the previous resection. The infarction was slightly less extensive, and the bowel had not assumed as dark a color as at the previous episode. Again the infarcted loop was rigid, due to edema and hemorrhage in its wall. Twenty-eight centimeters of bowel were resected and an end-to-end anastomosis was performed.

The postoperative course was stormy, with some degree of persistent ileus, which was treated with a Miller-Abbott tube. Depoheparin, 200 mg. daily, was started on the day following surgery and Dicumarol on the sixteenth postoperative day. The patient was discharged from the hospital on the twenty-sixth postoperative day under continued Dicumarol therapy.

Pathological Report (Microscopic): "Sections disclose a marked edema and dense polymorphonuclear cell infiltrations throughout the entire wall. There is, in addition, a marked hyperemia and infarction of the tissue. The sections of the small blood vessels show the lumina to be filled with laminated clot that is ante-surgical in appearance. *Diagnosis:* Acute infarction of the ileum" (Dr. Horace B. Davidson, Columbus, Ohio).

DISCUSSION

The segment of infarcted ileum showed a very narrow lumen. Its mucosal detail was obscured by the submucosal accumulation of fluid. The entire thickness of the bowel wall was opaque on the roentgenogram due to the high fluid content, and the outer margin of the bowel was well demarcated by the contiguous omental and mesenteric fat (Fig. 3).

The abdomen showed an absence of gas-containing bowel. In addition to the above described solitary loop, which did not contain any fluid levels, the ascending colon was deviated to the right lateral

abdominal wall by an extrinsic mass. This mass proved to be the infarcted loop of ileum with its edematous mesentery.

The obesity of the patient and the consequent heavy omental and mesenteric fat afforded the radiographic contrast necessary to outline the outer wall of the acutely infarcted segment of small intestine.

These roentgen findings occurred in an early mesenteric thrombosis which was localized to one loop of ileum. More extensive thrombosis with infarction of a greater portion of bowel would produce a much more generalized ileus. Harrington and Frimann-Dahl describe the x-ray findings in such cases. None of the diagnostic findings they describe specifically obtained in the case reported here.

Similar x-ray findings should presumably be encountered with intramural hemorrhage from a mesenteric vessel, bowel strangulation, localized inflammatory disease, or neoplasia with vascular or lymphatic obstruction.

SUMMARY

Localized mesenteric thrombosis in an obese patient was found to have caused sufficient edema and hemorrhage in the bowel wall to render the loop clearly visible radiographically. Preoperative diagnosis of mesenteric thrombosis was rendered possible by this finding.

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SUMARIO

Observación Radiográfica de Trombosis Mesentérica Localizada

Un sujeto de 65 años fué operado, sin examen roentgenológico, por lo que parecía ser, preoperatoriamente, apendicitis aguda. Se extirpó un segmento, infartado agudamente, de íleon, haciéndose un diagnóstico histopatológico de infarto hemorrágico del intestino y trombosis de la vena mesentérica. Nueve días después, el enfermo se quejó de recurrencia del dolor y de hiperestesia abdominal. Esta vez fué posible hacer un diagnóstico radiológico de trombosis mesentérica por el edema y la hemorragia de la pared intestinal, que dejaba ver claramente el asa afectada.

Preliminary Observations Regarding Value of a Very Fine Focus Tube in Radiologic Diagnosis[1]

ERNEST H. WOOD, M.D.

ENGINEERING developments of recent years, especially perfection of the rotating anode tube, have made possible smaller focal spots for radiographic use. When the tube has a focal spot measuring a fraction of one millimeter, fine detail in radiographs may be preserved even when magnification of the part examined is accomplished. Under certain conditions, image magnification would appear to give additional information to the radiologist, as compared with ordinary methods. The advantages and limitations of a very fine (fraction of 1 mm.) focus tube in clinical practice, however, have not yet been thoroughly worked out. It is the purpose of this paper to present some studies concerning the practical value of a tube with a focal spot of 0.3 mm. for radiologic diagnosis.

RADIOGRAPHY WITHOUT MAGNIFICATION

The more nearly the focal spot of a radiographic tube approaches a point source of radiation, the finer the detail in the resulting radiograph. Films of exceptional diagnostic quality can be obtained by employing the 0.3 mm. focus tube at normal target-film and object-film distances, with or without the use of a Potter-Bucky diaphragm. Reduction of focal spot size, however, to a fraction of a millimeter unfortunately requires the use of relatively low milliamperage, with the result that long exposure times are necessary. Between 10 and 15 ma. is the most useful range for ordinary work. With 15 ma., which are used for the majority of examinations, the tube may be operated at 80 kv. for fifteen seconds; if the load is reduced to 10 ma., the tube may be operated at 100 kv. for fifty seconds. The tube ratings furnished by the different manufacturers of the equipment commercially available in this country are almost identical (Fig. 1).

An interesting use of the very fine focus tube is its application to laminagraphy. Here, relatively long exposure times and low milliamperage are desirable to allow full motion of the radiographic tube and the film holder. Body sections of fine radiographic detail can be obtained by use of the fine focal spot of the x-ray tube.

An unusual method of producing laminagrams, employing the very small focal spot tube, has been devised by Abel (1). In this method, the distance between the x-ray tube and film is varied throughout the exposure, but a fixed relation of the distances to one plane of the object is maintained. The images of structures in other planes of the body are poorly defined in the resulting radiograph, while structures in the plane of fixed distance ratio of tube and film are clearly depicted.

Use of the 0.3 mm. focus tube at normal object-film distance has been found to be of definite clinical value. Ordinary methods of making facsimiles of radiographs for public demonstration unfortunately fail to capture the great difference in detail between films made with a 0.3 mm. focal spot and those made with a 1.0 mm. focal spot. It is useless, therefore, to present here reproductions of films made at normal distances for comparison. On the contrary, the quality of enlarged radiographs is readily seen when ordinary images and

[1] From the Department of Radiology of the School of Medicine of the University of North Carolina and the Radiologic Service of the University Hospital, Chapel Hill, N. C.
A portion of the work described was carried out on the Radiologic Service of the Columbia-Presbyterian Medical Center, New York, N. Y., Ross Golden M.D., Director.
Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

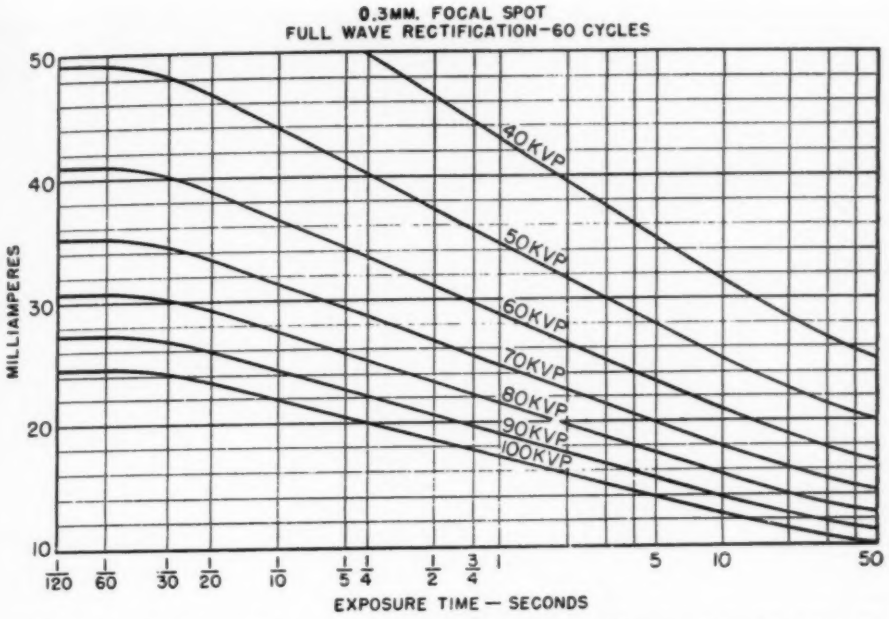

Fig. 1. Capacity curves of a commercially available 0.3 mm. focal spot radiographic tube. The rating by kilovoltage reveals that exposures of 50 seconds length may be employed even at 100 kv. if low milliamperage is used. Very short exposure times do not allow delivery of a sufficient quantity of radiation for ordinary radiography (Stevenson).

twice enlarged images are equally reduced in an illustration (Fig. 2).

THE TECHNIC OF RADIOGRAPHIC MAGNIFICATION

Some enlargement of the part examined is present in all radiographs. The amount of enlargement varies with the mean distance between the object of interest and the film and it is related to the target-film distance. The mean object-film distance is dependent upon the thickness of the part and whether or not a Potter-Bucky diaphragm is interposed. Images of varying magnification may be produced at will by altering the geometric relationship between the source of radiation, the object, and the film. In order that sufficient detail for roentgen diagnosis may be

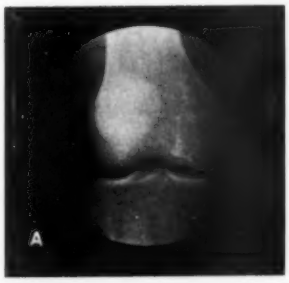

Fig. 2. Osteochondritis dissecans and Pellegrini-Stieda disease of the knee. When conventional radiographs (A) and radiographic enlargements (B) are equally reduced, a comparison of the image size can be made in facsimiles. Radiographic detail is preserved with twofold enlargement when the 0.3 mm. focal spot tube is employed. →

Fig. 3. Osteogenic sarcoma of the tibia. The magnification with a conventional 1.5 mm. focal spot (A) and the magnification with the 0.3 mm. focal spot (B) are compared. Radiographic enlargement with ordinary apparatus is impractical because the penumbral shadow produced by the large focus results in a radiograph of poor definition (see Fig. 4). On the contrary, films of good diagnostic quality are obtained with twofold or threefold image enlargement when the very fine focal spot tube is employed.

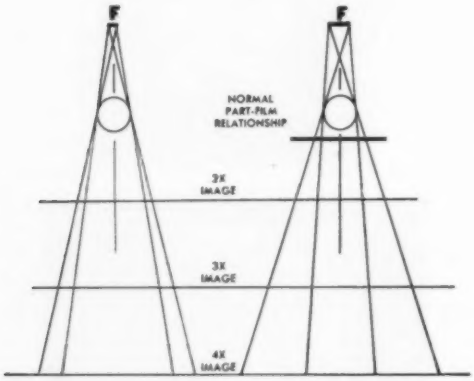

Fig. 4. Relationship of focal spot size to unsharpness of the radiographic image. A focal spot of ordinary width (right) produces a small penumbra at conventional object-film distance, and a very large penumbra, resulting in a blurred image (see Fig. 3), at extended object-film distance (Garnes). The 0.3 mm. focal spot (left) produces approximately the same degree of ill definition in a twofold enlargement as is produced by the 1.5 mm. focal spot (right) at normal radiographic distance.

preserved with enlargement, however, a tube with a very small focal spot, such as the one under discussion, is required. If a conventional focal spot be employed, the large penumbral shadow and the small image shadow make magnification useless (Figs. 3 and 4).

Although geometry and optics dictate the useful range of radiographic magnification, experiments were carried out employing a variety of factors to determine the most practical way to give reproducible technical results of optimal clinical value. For this purpose, a tunnel with multiple levels of support for a cassette tray was used to provide a free variation of the object-film distance. The film position was altered from table contact to 36 inches below the top of the radiographic table. Further magnification was produced by reducing the target-object distance.

These experiments indicate that the maximal useful magnification of anatomic structures by this method is an enlargement of approximately three times normal size. Further enlargement results in a penumbra which forms a significant part of the total shadow of the object. However, enlargement to twice the normal size appears to be optimal for routine clinical work.

A simple method of producing a double-sized image is to place the focal spot of the radiographic tube 24 inches above and the film 24 inches below the object. For practical clinical purposes, it is satisfactory to place the anode of the x-ray tube 24 inches from the top of the radiographic table and the cassette an equal distance beneath the table. This disposition allows easy positioning of any heavy part of a patient between the radiographic tube and the table top. The equal relation of the tube and film to the table top results in a slightly greater than double magnification of the interposed object, which, nevertheless, is usually referred to as a twofold radiographic enlargement.

The quantity of radiation, measured in milliampere-seconds, required to produce enlargements usually is slightly greater than in ordinary radiography because of the extended target-film distance. The radiation dosage delivered to the patient, as measured in roentgens, is increased approximately three times because of the shorter target-skin distance and the increased exposure time. The small focal spot tube is best suited to the examination of parts which can be thoroughly immobilized. Results are not always satisfactory with active children, with structures which pulsate vigorously, or with other moving objects.

Early in the application of the enlarged image technic it became apparent that for heavy parts every practical method of reducing scattered radiation would be necessary. A radiographic cone, extended to the patient's skin surface, was found helpful for all but the smallest anatomic parts,

Fig. 5. Method of radiographic enlargement in examination of the leg. A radiographic cone is used and extends as near the patient as inclusion of the entire field of interest allows. A Potter-Bucky diaphragm is carried on rails at a distance of 48 inches below the top of the table. Disposition of the radiographic tube and the film at equal distances from the object produces twofold enlargement.

in order to prevent an overall grayness of the film. Grid-front cassettes were used to eliminate scattered radiation in examining dense parts, such as the hip, skull, and spine. A Potter-Bucky diaphragm with a 48-inch focus grid finally was used to eliminate as much as possible of the scattered radiation, and such a device is preferred to the use of grid-front cassettes (Fig. 5). Even with the moving grid, radiographic detail is so difficult to preserve in the examination of heavy parts that careful coning of the primary beam is always essential for best results.

CLINICAL EXPERIENCE

The skeletal system has been, thus far, the area in which the enlargement technic has had its greatest usefulness. Magnification of the axial as well as the appendicular skeleton has been proved technically

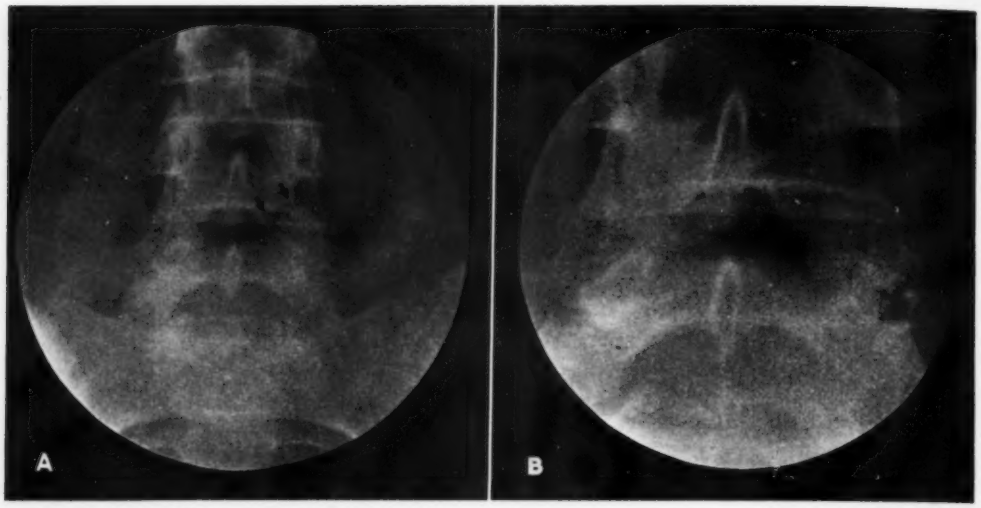

Fig. 6. Suspected fracture of inferior articular process of L-4. A 43-year-old man sustained a direct blow to the lumbar spine in an automobile accident. A conventional film (A), made the day of injury, disclosed a reproducible oblique line of diminished density extending across the left inferior articular process of L-4 (arrows), which suggested the possibility of fracture. The radiographic enlargement (B) revealed a smoothly irregular bone cortex and an unusual grouping of bone trabeculae superimposed upon the margin of the contiguous articular process, which are normal anatomical variations. Nothing suggestive of osseous discontinuity resulting from fracture was shown in the enlarged view.

possible and is advantageous in radiologic diagnosis. In some instances, additional information is gained, while at other times visualization of skeletal lesions only is made easier.

Fracture of certain bones may best be determined from radiographic enlargements. Deformity of the carpal navicular, impacted fractures of the femoral neck, and irregularity of the arches of the vertebrae may be visualized to better advantage in enlarged radiographs than in conventional films. In many instances, apparent diminished density suggesting discontinuity of bone due to trauma may be difficult to interpret from ordinary radiographs. The enlargement method, thus far, seems to be more helpful in excluding fracture than in actually detecting bone damage when questionable linear shadows of diminished density are observed in conventional films (Fig. 6).

Infections, tumors, and degenerative diseases of bones and joints are lesions for which radiographic enlargements are often helpful in diagnosis (Van der Plaats and Fontaine, 4). In one of our cases, the radiologic diagnosis of osteomyelitis of a lumbar vertebral body was made possible by the demonstration of multiple small areas of osteolysis, in one of which a tiny sequestrum was disclosed (Fig. 7). These changes could not be appreciated, even in retrospect, in technically good routine films of the vertebral column.

In the diagnosis of intracranial lesions, the changes in the sella turcica are of the utmost diagnostic significance. When sellar damage is extensive, a careful analysis of the remnants of bone may give a clue to the nature of the pathologic process. The thin curvilinear calcium shadow of a posterior clinoid process or of the sellar floor, if clearly demonstrated, may suggest an expanding intrasellar lesion as opposed to erosion of the sella from external pressure. Enlarged radiographs of the skull have been used successfully also by Zimmer (5) for the study of the mastoids and the paranasal sinuses. The value of the enlargement method in dental radiography has been emphasized. Twofold enlargements enabled Zimmer to detect roentgen changes in skull structures hitherto invisible.

Added information regarding the structure of a pathologic soft-tissue calcification, gained through object magnification, may be helpful in evaluation of its significance. In some instances, calcium shadows which appear amorphous in ordinary films will be seen in enlarged radiographs

Fig. 7. Osteomyelitis of L-3. Analysis of the enlargement makes possible identification of multiple osteolytic lesions of the vertebral body, one of which contains a tiny sequestrum (arrow). Previous conventional films had shown fairly well the destructive process in the right inferior portion of the vertebral body of L-3 and other abnormal shadows, but sequestration was not shown except in the enlargements.

to have a definite internal arrangement of component calcium deposits. Unfortunately, this detailed demonstration of component parts of an object by enlargement cannot be extended indefinitely. A particle smaller than the focal spot itself cannot be successfully magnified because extension of the rays over the margins of the object then results in an image of indistinct outline (Fig. 8).

Pulmonary shadows have been studied by enlargement to a limited extent. In the lung and other viscera, vascular pulsations may preclude the use of radiographic methods which are not rapid. The production of enlarged radiographs at the time of bronchography, however, has shown that even

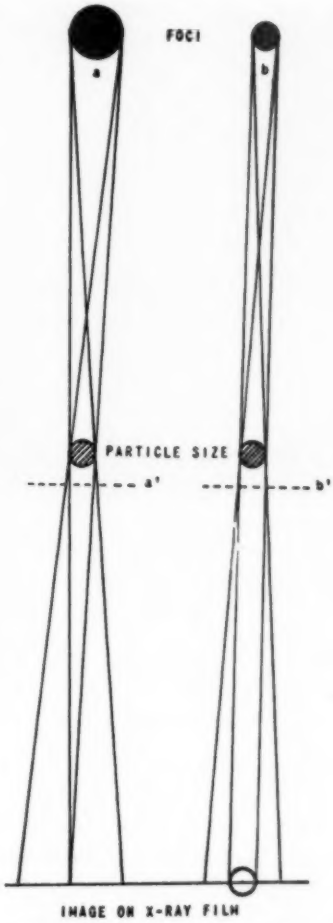

Fig. 8. Relationship of focal spot size and particle size to the radiographic image. The smallest component of an object that can be seen with good detail in a twofold enlargement parallels the size of the focal spot of the radiographic tube. Particles smaller than the focal spot are not satisfactorily visualized because a portion of the x-ray beam sufficient to cast a clear shadow on the film is not interrupted (Garnes).

central shadows which are in proximity to pulsating vessels but which themselves do not pulsate can often be visualized with good definition. A number of lesions of the lung periphery, where the influence of transmitted vascular movement is least marked, have been investigated very successfully by enlargement technics (Fig. 9). Fine detail may not be preserved in the

Fig. 9. Pulmonary infarct. Intrapulmonary lesions, particularly those which lie near the periphery of the lung, may be satisfactorily examined by radiographic enlargement. The well defined outline of the left cardiac border is noteworthy.

magnification of pulmonary lesions as well as in the examination of bone, but diagnostically helpful information often may be obtained.

Stereoscopic pairs of enlarged radiographs can be produced by shifting the radiographic tube a distance of 2 inches between exposures. Perhaps here lies one of the greatest advantages of this interesting procedure. In selected cases, usually difficult clinical problems, the ability to resolve and analyze radiographic shadows by unhurried study of stereoscopic enlargements is of great advantage.

The teaching value of enlarged radiographs is worthy of further investigation. It is often possible to emphasize details of diagnostic importance to students by employing methods which enlarge the radiographic image of a pathologic process. Gross enlargement by the best modern methods of projecting radiographs onto a screen is not always a satisfactory substitute for direct viewing of the film. An enlarged radiograph permits more students to examine the film at the same time, since it can be seen clearly from a greater distance.

COMMENT

Direct radiographic enlargement of a subject has certain advantages over conventional radiography and also over photographic methods of image enlargement. Photographic enlargement involves the making of an intermediate positive film by photographing the radiograph and then making an enlarged facsimile of the original radiograph by ordinary projection methods. A distinct advantage of radiographic enlargement is that it is rapid and lends itself to wet film diagnosis. Disadvantages are the special apparatus required and the consumption of large film. Now the very fine focus is combined with a conventional focus in an ordinary double-focal-spot tube housing, which eliminates the necessity of segregating one diagnostic area for the production of enlarged radiographs.

At the present stage of preliminary evaluation, the very small focus tube appears to be a helpful tool for the radiologist when used either with or without magnification technics. Its clinical usefulness seems to be sufficient to warrant its inclusion as an item of standard equipment in large hospitals.

SUMMARY

1. A radiographic tube having a focal spot measuring a fraction of a millimeter (0.3 mm.) is now commercially available. Preliminary observations indicate that this tube has important clinical value in ordinary radiography and for radiographic enlargement.

2. Enlarged radiographic images are valuable because they often give information to the radiologist which is difficult or impossible to obtain from conventional films.

3. Lesions of the skeletal system, in particular, are suitable for examination by enlargement methods. The full clinical importance of radiographic enlargement of other parts of the body has not yet been thoroughly evaluated.

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SUMARIO

Observaciones Preliminares Acerca del Valor de un Tubo de Foco Muy Fino en el Diagnóstico Radiológico

Mientras menor el punto focal del tubo radiográfico o sea más parecido a un punto, más delicados son los detalles en la radiografía obtenida. Ya hay accesible en el comercio un tubo radiográfico cuyo punto focal mide una fracción de milímetro (0.3 mm.). Las observaciones preliminares indican que este tubo posee importante valor clínico para la radiografía corriente y para la ampliación radiográfica.

Las imágenes radiográficas agrandadas son valiosas porque a menudo aportan al radiólogo información que es difícil o imposible obtener por medio de las radiografías ordinarias. Una ventaja precisa de la ampliación radiográfica sobre la fotográfica consiste en ser rápida y en prestarse para el diagnóstico en película húmeda.

Las lesiones del sistema esquelético, en particular, se prestan para examen con las técnicas de ampliación. No se ha apreciado todavía completamente la plena importancia clínica de la ampliación radiográfica de otras partes del cuerpo.

DISCUSSION

Lewis E. Etter, M.D. (Pittsburgh, Penna.): It is a distinct pleasure to discuss this very excellent paper of Dr. Wood. We have had some experiences with the ultrafine focus tube in Pittsburgh during the past year and have found it of considerable value in extending our investigations of some cases. The direct radiographic enlargement technic is not one the radiologist is likely to use in routine studies, but when a tube replacement is needed in the department it might be well to consider the substitution of one of these tubes for the old one. Thus, one may have both a 1.0 or 2.0 mm. focal spot, plus a 0.3 mm. focal spot in the same rotating anode tube for use in supplementary examinations.

Many have asked if it is not possible to secure the same result by photographic enlargement. Such enlargements lack sharp detail because the penumbra unsharpness of the image is magnified as well as the unsharpness due to screen grain, which is as much as 0.5 mm. at the usual distances, and may be as high as 0.8 or 0.9 mm.

I would like to illustrate my further remarks by several examples.[1] Here we have a conventional roentgenogram on the right hand side, and a four times enlargement of the wrist and hand on the left. On the original film on the right you cannot appreciate the details of the fracture in the capitate bone that can be seen on the film at the left. There was a question on the conventional film of whether or not there was also an associated fracture of the scaphoid bone. It anc be seen on the enlargement at the left that there is a slight irregularity of the cortex of the scaphoid bone, but I believe this is solely an anatomical variation and there is no evidence of an actual fracture. There is only a fracture of the capitate bone.

Next, I would like to describe a tumor of the lesser trochanter of the femur in which there appeared to be some possibility of irregularity of the margin, with actual breaking through, with a question between chondrosarcoma with breakthrough in contrast to osteochondroma. This turned out to be an osteochondroma at operation and on pathological section. I believe our preoperative diagnosis was supported by the fact that on the enlarged view we could quite clearly see that there was no actual break in the cortex at any point.

The direct radiographic enlargement technic may be applied to the nasal bones. The normal anatomy may be studied beautifully on a twofold enlargement. I believe that the vascular grooves and nerve channels show up much better than

[1] Films shown at this point.

they do on the conventional film. It is also of note that the soft-tissue detail of the open and closed eyelids shows up very well on such films. In some cases on the conventional film there will be seen what appears to be a comminuted fracture of the nasal bone. But on the enlarged view one can see that the fracture is a single line, and another line of decreased density, which one might think of as a comminution, is actually an aberrant vascular or nerve groove.

In a patient who had an eosinophilic pituitary gland tumor with acromegaly, there was some difficulty experienced in study of the clinoid processes on the conventional films. The preliminary film showed the usual signs of an intrasellar lesion, but we were not sure about the status of the anterior clinoid processes. We thought that perhaps there was something wrong with one of them, but it was not quite clearly demonstrated. It appeared that we had rather bulbous anterior clinoids and that one might be superimposed on the other. When we made our enlarged views ($\times$ 2), we thought we could see that one of these clinoid processes was quite eroded and the other one was of normal size and shape. On a stereoscopic pair, such as can be made with a 2-inch shift of the tube, as Doctor Wood showed, it was quite clear we had only one anterior clinoid process, while the other was completely eroded. This and the other associated signs of an intrasellar lesion were clearly shown in the enlarged views.

We believe that direct radiographic enlargement technics may reveal details that are not appreciable on conventional studies and may be of much use as a supplementary method of investigation in selected cases.

Dr. Abrams: I would like to ask one question of Dr. Wood. I wonder whether or not he thinks that the value of the fine focal spot would be enhanced in a mobile unit, granted that the engineering problem could be worked out well and the exposure time need not necessarily be longer than in a fixed stationary unit. This is a practical problem which arose in our department, and I would appreciate some comment on it.

Dr. Wood (*closing*): I wish to thank Doctor Etter for his kind remarks, for his thought-provoking comment and for the interesting report of his own experience with enlargement radiography.

Dr. Abrams has inquired about the feasibility of using the 0.3 mm. focal spot tube with a mobile generator and control. Such an assembly has been investigated and engineering details are being worked out. There is no danger of damage to the tube with a self-rectified circuit, but the radiation output is too low for clinical work, since exposure time is very long. Development of full-wave rectification is desirable, and this is not difficult. By having a very fine focal spot tube mobile, we hope to take advantage of more of the facilities of our department, *e.g.*, phototiming. Employment of the apparatus in the operating room during surgical procedures may prove to be advantageous for the demonstration of loose bodies in the knee joint and for the detection of bile duct calculi by cholangiography.

Thiouracil Modification of Effect of Radioiodine (I^{131}) on the Thyroid[1]

ROBERTS RUGH, PH.D.

THE RATHER thorough destruction of the thyroid gland by injection of experimental animals with large doses of radioiodine has been demonstrated by Reinhardt (37), Leblond (28), Chapman (9), Findlay and Leblond (13), Gorbman (18), Chaikoff and Taurog (8), Freedberg and Kurland (14), Winchester, Comar, and Davis (46), Shapiro (41), and Rugh (38, 39). It is of interest to determine whether the histologic reaction of the intact thyroid to injected radioiodine might be altered by pretreatment of the animal with one of the antithyroid compounds, namely thiouracil. The salamander, *Triturus pyrrhogaster*, was chosen because it has a relatively low metabolic rate and any changes that occur could be studied over an extended period. A further advantage is the fact that the constituent cells of the amphibia are among the largest and the most satisfactory for study in the entire animal kingdom.

MATERIALS AND METHOD

The specimens of *Triturus pyrrhogaster*, the Japanese fire salamander, had been kept under laboratory conditions for over a year. Fully grown, sexually mature females weighing at least 8 gm. were selected for this study. The animals were maintained at a constant temperature of 15° C., in tap water, and were fed raw liver once each week.

The thiouracil was received from Parke, Davis and Co. in powder form and was used in a 1 per cent suspension in saline. It was injected intraperitoneally on days 1, 4, 6, and 20. Since 10 mg. of the drug were injected each time, over the three-week period, each of the salamanders thus treated received a total of 40 mg. of the antithyroid substance.

The radioiodine was received directly from the pile at Oak Ridge and was in the form of carrier-free sodium iodide (NaI^{131}). It was diluted with distilled water so that the final concentration was 100 μc./c.c. A single intraperitoneal injection of 0.25 c.c. —25 μc. of radioiodine—was given some of the experimental animals on the twenty-second day following the first injection of the thiouracil. The observation period began as of the day the I^{131} injection was made, the thiouracil-treated animals having had a pretreatment with the antithyroid drug of three full weeks.

A total of 48 salamanders was involved in these experiments, divided into four groups as follows: 12 controls, 12 treated with thiouracil, 12 treated with radioiodine, and 12 treated with thiouracil followed by radioiodine injection.

At intervals of one week, one month, two months, and seven months, 3 animals from each of the above groups were sacrificed. The thyroid and the anterior pituitary glands were preserved in Bouin's fluid and subsequently sectioned at 5 microns and stained with Masson trichrome stain or Delafield's hematoxylin.

OBSERVATIONS: THE THYROID GLAND

Control Group: The normal *Triturus* thyroid has from 11 to 14 follicles of rather uniform size and consistency in any median cross section. The gland has a maximum diameter (thickness) of about 0.9 mm. It is a uniformly active gland, with tall columnar-type epithelium having a maximum height of about 35 microns. The nuclei are generally oval, with their long axes directed toward the center of the follicle and measuring as much as 17 microns. The colloid is abundant but not heavy, its peripheral margins giving

[1] From the Radiological Research Laboratory, Columbia University, New York. This document is based on work performed under Contract AT-30-1-GEN-70 for the Atomic Energy Commission. Accepted for publication in November 1952.

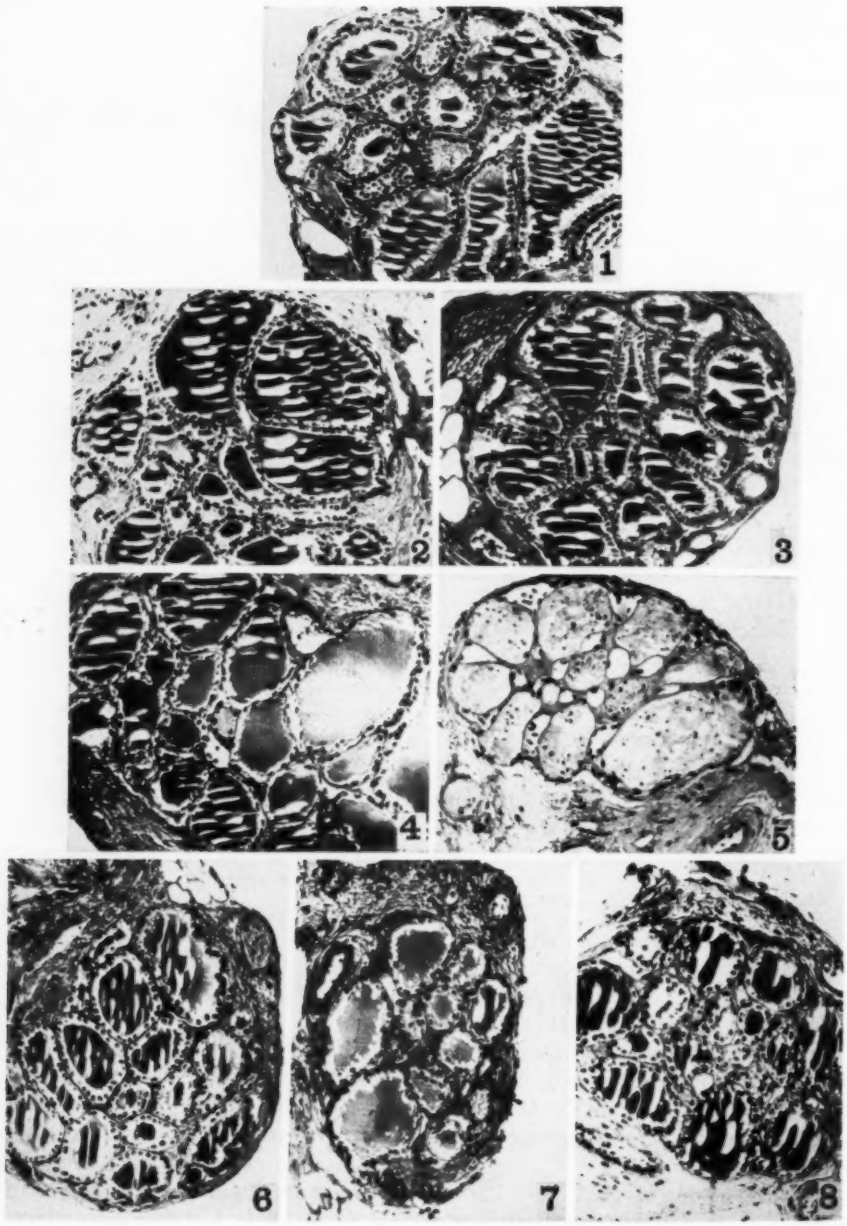


PLATE I

Fig. 1. Normally active thyroid of control, adult female *Triturus pyrrhogaster*.

Fig. 2. Thyroid of adult female which had received a total of 40 mg. of thiouracil over a period of twenty days ending one month previously. Note slight enlargement of the gland, with abundant stored opaque colloid. Epithelium low and nuclei flattened.

Fig. 3. Thyroid of salamander receiving the same treatment as that of Fig. 2, removed two months after termination of thiouracil treatment. Colloid still dense, with slight evidence of return of epithelium to normal activity. Gland reverts to normal.

Fig. 4. Thyroid of adult female salamander one month after being injected intraperitoneally with 25 μc. of I^{131}. Note destruction of follicular epithelium, and colloid variable and in stasis.

Fig. 5. Thyroid of salamander treated as for Fig. 4 but two months after injection. Note further destruction of follicular epithelium and degeneration of the colloid. Evidences of hyper-

vacuolar evidence of resorption (Figs. 1 and 9).

Thiouracil Group: One month following injection with thiouracil the thyroid gland is enlarged slightly, to a maximum of about 1 mm. in cross section (Fig. 2). Individual follicles may measure as much as 0.4 mm. in cross section. Some of the follicles appear to be expanded by the contained colloid. The colloid is heavy, uniform in consistency, and is not vacuolated. The epithelial height is reduced to a maximum of about 16 microns. The epithelial nuclei are oval but tend to lie with their axes parallel to the basement membrane (Fig. 10). They measure as much as 6.0 microns in maximum length.

By two months after treatment the thyroid gland appears to have returned to the normal (control) state (Fig. 3). The columnar epithelium of the follicles often measures as much as 34 microns and the nuclei are generally oval, with their long axes in the direction of the center of the follicle and measuring as much as 17 microns. They are normally granular (Fig. 11). The epithelium is actively secretory, and the colloid is somewhat vacuolated. The effect of the thiouracil treatment seems, therefore, to be transient, appearing first between the first and the fourth weeks and disappearing before eight weeks. The gland is very much like that of the controls (Figs. 3 and 1). Seven months after treatment the thyroid gland of the thiouracil-treated salamander is entirely normal (Figs. 16 and 17).

Radioiodine Group: The single injection of 25 μc. of radioiodine had no appreciable effect on the thyroids within the first week. However, by one month the follicular epithelium began to show signs of destruction (Fig. 12). Its maximum height was about 27 microns, but the largest nuclei still measured about 12 microns in their long axes. The epithelium gave evidence of destruction, being thin and highly vacuolated. Often the edges were frayed and indistinct. Their nuclei varied in diameter from 6.8 to 20.4 microns and were irregular, from oval to round. Their contained granules tended to be concentrated around the periphery, close to the nuclear membrane, and many appeared to be dead. The cytoplasm, however, showed the greater damage. The gland as a whole was reduced in cross section to less than 0.70 mm. The follicles were variable in their colloid reserve, the innermost follicles giving evidence of the greater damage (Fig. 4).

At two months following radioiodine injection the thyroid was almost completely devoid of any of the characteristics of the normal gland. It varied in maximum size, in different animals, from 0.4 to 0.7 mm. in diameter (Fig 5). There was widespread hyperemia, the colloid was fibrous and depleted, and the epithelium was entirely gone except for an occasional stray epithelial nucleus (Fig. 13). The interfollicular tissue appeared to be of a thickened fibrous connective type. The gland in this state could not possibly have any secretory or metabolic function.

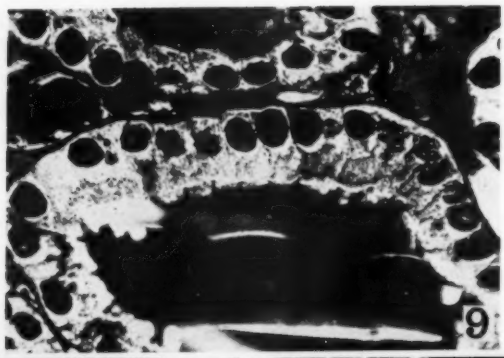
By seven months after injection, the I^{131}-treated salamander had an extremely small and necrotic thyroid gland (Figs. 18, 19), with only ghost-like remnants of follicles, some fibrous colloid, some hyperemia, but no follicular epithelium whatever.

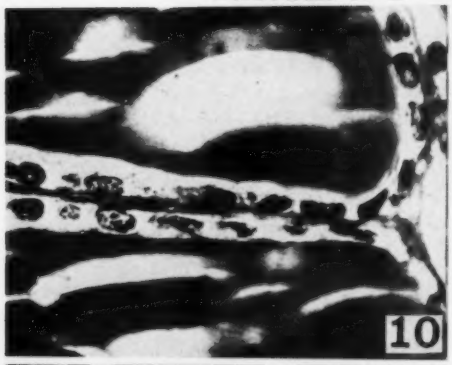
Thiouracil-plus-I^{131} Group: The thyroids of salamanders pretreated with thiouracil and then given 25 c.c. of NaI^{131} showed no change at one week. At one month they were still very much like the

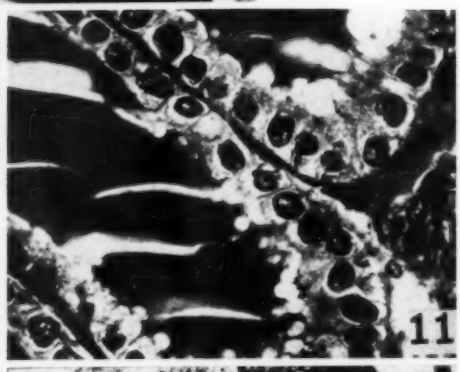
emia of thyroid blood vessels, and necrosis of thyroid tissue, with replacement of epithelium by connective tissue. Not much reduction in size of the gland, however.

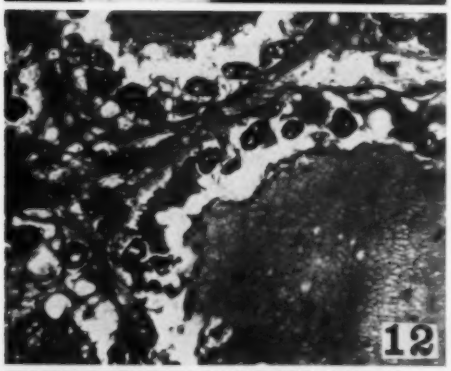
Fig. 6. Thyroid of adult female salamander subjected to thiouracil treatment for three weeks and then given 25 μc. I^{131} (a combination of conditions illustrated in Figs. 2 and 4), showing the protective value of pretreatment with the antithyroid substance one month later. Gland appears quite like that of the control shown in Fig. 1.

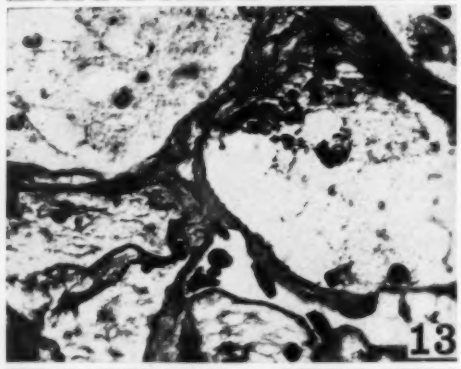
Figs. 7 and 8. Thyroids of salamanders treated with thiouracil and I^{131} (see Fig. 6) after a lapse of two months following treatment with I^{131}. Note variation in glands from two animals similarly treated, with the greater damage shown in Fig. 7. Nevertheless, when either Fig. 7 or Fig. 8 is compared with Fig. 5, the nature and the degree of protection of the thyroid by pretreatment of the animal with thiouracil is indicated.

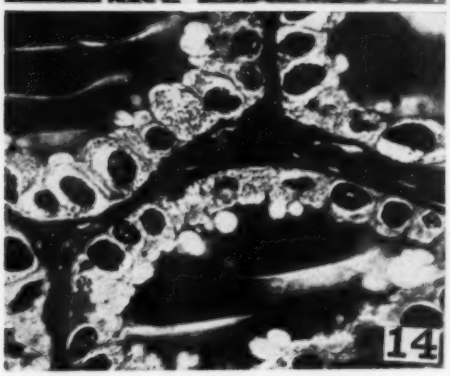












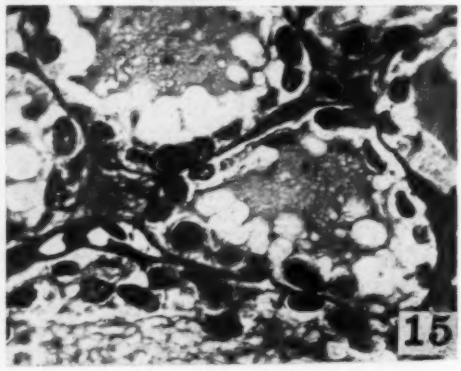


PLATE II

controls (compare Figs. 6 and 1). The maximum cross section of any gland thus treated was 0.74 mm. The epithelial height reached a maximum of 27.2 microns. The epithelial cytoplasm was intact and gave evidence of secretory activity (Fig. 14). The colloid of the follicles was normal in consistency and somewhat vacuolated at the margins. The epithelial nuclei were quite normal except that some of them were lying with their long axes parallel to the underlying basement membrane, as in the thiouracil-treated animals. The maximum length of the oval nuclei was 17 microns, but there was not much variation among the nuclei. On the whole, the gland could be confused easily with that of the control salamanders (compare Figs. 6 and 1 with 14 and 9).

By two months the gland of the thiouracil-radioiodine-treated animals was slightly reduced in cross section (0.65 mm.) and there was present abundant follicular epithelium (Figs. 7 and 8). This epithelium did not appear as healthy as that of the controls. The cytoplasm gave the impression of heightened activity in some of the follicles and of minor damage in others. Colloid was present but was variable in consistency and in some follicles was vacuolated. The nuclei were generally oval, with a maximum length of 17 microns (Fig. 15). There was some evidence of fibrotic changes in the interfollicular regions, but no particular hyperemia (Figs. 7, 8, 15).

These experiments were terminated seven months following the injection of radioiodine into the salamanders, and the results at this time are illustrated on Plate III. The thyroids of salamanders treated with thiouracil and then with I^{131} showed variable response (Figs. 20 and 22), some being reduced more than others and some showing less normal colloid than others (Figs. 21 and 23). Nevertheless, there was protection of the gland in some specimens (Figs. 20 and 21) even after seven months, for in contrast with those animals given I^{131} alone (Figs. 18 and 19) there was some rather normal appearing colloid present (Fig. 20 and 21) even though this often contained the sloughed-off epithelial cells from the secreting follicle.

THE PITUITARY GLAND

While the cytological changes in the anterior pituitary gland were slower to develop than those in the thyroid, they were nevertheless apparent as early as one month after treatment in some of the experimental conditions.

With the *thiouracil treatment alone*, there was a slight increase in the proportion of true basophils after one month. In two months, however, the glands had returned to the normal state, at which they remained to the end of the observations at seven months. The pituitary at these times could not be distinguished from that of the controls.

In the salamanders *treated with I^{131} alone*

Fig. 9. Thyroid of control adult female *Triturus pyrrhogaster*. No treatment with either thiouracil or I^{131}. Environmental conditions identical with those for the experimental animals.

Fig. 10. The effect of thiouracil on the thyroid gland of *Triturus* at one month. Injections totaled 40 mg. over twenty-day period, following which there was one month without further treatment. Note flattened follicular epithelium and accumulation of colloid. Nuclei with long axes parallel to basement membrane.

Fig. 11. Thyroid two months following treatment with thiouracil, showing resumption of normal secretory activity. (Compare with Fig. 9)

Fig. 12. Thyroid of *Triturus* adult female one month after a single injection of 25 μc. of I^{131}, showing extensive epithelial damage and abnormal colloid.

Fig. 13. Thyroid of *Triturus* adult female two months after I^{131} treatment, showing complete destruction of the thyroid gland. Epithelium lost, no colloid, and interfollicular stroma appearing more as fibrous connective tissue.

Fig. 14. Thyroid of *Triturus* one month after cessation of thiouracil treatment and single injection of 25 μc. of I^{131}. Note degree of protection of the thyroid by pretreatment with the antithyroid substance (compare with Fig. 6). Epithelium intact (see Fig. 12, showing effect of I^{131} alone) and secretory (compare with Fig. 10 showing effect of thiouracil alone).

Fig. 15. Thyroid of *Triturus* two months after combination treatment of thiouracil followed by I^{131}. Note quite normal epithelial nuclei; active epithelium; colloid secretion. Compare with Fig. 11 for effect of thiouracil alone and with Fig. 13 for effect of I^{131} alone after comparable interval.

(25 μc. in a single injection), the anterior pituitary gland at one month after injection was normal, but by two months there was some evidence of edema and a slight increase in the percentage of basophils. By seven months the gland was not measurably larger but contained fewer cells (*i.e.*, the cells were less compact). The basophils were slightly decreased in favor of chromophobes, most of which had enlarged pale blue cytoplasm. These were concentrated toward the center of the gland. Some of their cytoplasm appeared to be vacuolated, much in the manner of the so-called castrate cells which appear in the pituitary following total thyroidectomy. Some of the oval nuclei were enlarged to a maximum of 2 microns (normal about 1.7 μ) in maximum length. The gland as a whole appeared to show some signs of degeneration.

The anterior pituitary gland of salamanders *treated with thiouracil and then with radioiodine* did not show the changes observed in those treated with I^{131} alone. By two months after treatment there were more true basophils than under any other experimental or control condition. This might have been a response to the synergistic action of thiouracil and I^{131}. The gland as a whole appeared to be quite normal at seven months except for some very slight edema and a few centrally placed pale blue chromophobic cells. There was no preponderance of basophils as seen earlier in the gland, and there was little evidence of the destruction found in the glands of animals treated with I^{131} only.

The anterior pituitary gland does not respond as rapidly as does the thyroid to the various experimental conditions imposed. Nevertheless, there were cytological changes which seemed to parallel those in the thyroid.

DISCUSSION

Thyroid-stimulating compounds, iodine and radioiodine, and antithyroid substances have been used on lower animal forms such as the snail (Sobel, 42), the fish (Matthews and Smith, 33; Lever *et al.*, 30), the amphibia (Gordon *et al.*, 19; Joel *et al.*, 24; D'Angelo and Gordon, 11; Kaltenbach, 25; Matthews, 32; Bradley, 7), and the fowl (Larson *et al.*, 27; Vanderlaan and Bissell, 43; Wheeler and Hoffmann, 44, 45; Rawson *et al.*, 35; Bezem *et al.*, 5; Adams and Craig, 1; Adams and Buss, 2). There are innumerable studies on mammals, including man, but reference will be made to only a few of the most pertinent ones.

Rawson *et al.* (36) demonstrated a marked reduction in the thyroid uptake of radioiodine following the oral administration of thiouracil to rats, and functional thyrostasis was produced in rabbits by Baumann *et al.* (3). Nodular hyperplasia of the gland was induced by thiouracil treatment by Laquer (26), and Schulman (40) found that the thiouracil fed to rats was oxidized in the thyroid gland to sulfate, preventing the formation of organically bound iodine by means of saturating the mechanism by which iodide was oxidized in the gland. Montag (34) used thiouracil to stimulate mitotic activity in the thyroid so that the cytological effects of direct x-irradiation of the gland might be exaggerated and studied better.

Combination studies with x-radiation in rats suggested that pretreatment with thyroid and antithyroid substances altered the general body metabolism and thereby affected the susceptibility of the animal to ionizing radiations. There seemed to be no evidence that the pretreatment with various drugs altered the thyroid gland itself with respect to the irradiation (Bender, 4; Blount and Smith, 6; Hursh *et al.*, 23; Haley *et al.*, 20–22; Limperos and Mosher, 31; Clausen, 10). Limperos and Mosher (31) believe that thiourea lowers the radiation mortality because of the protection afforded to certain vital constituents such as nucleic acid, and possibly also to sulfhydryl-containing enzymes, ascorbic acid, and glutathione. It seems that only very high doses (5,000 r) of x-rays directly to the thyroid gland will bring about damaging changes, and

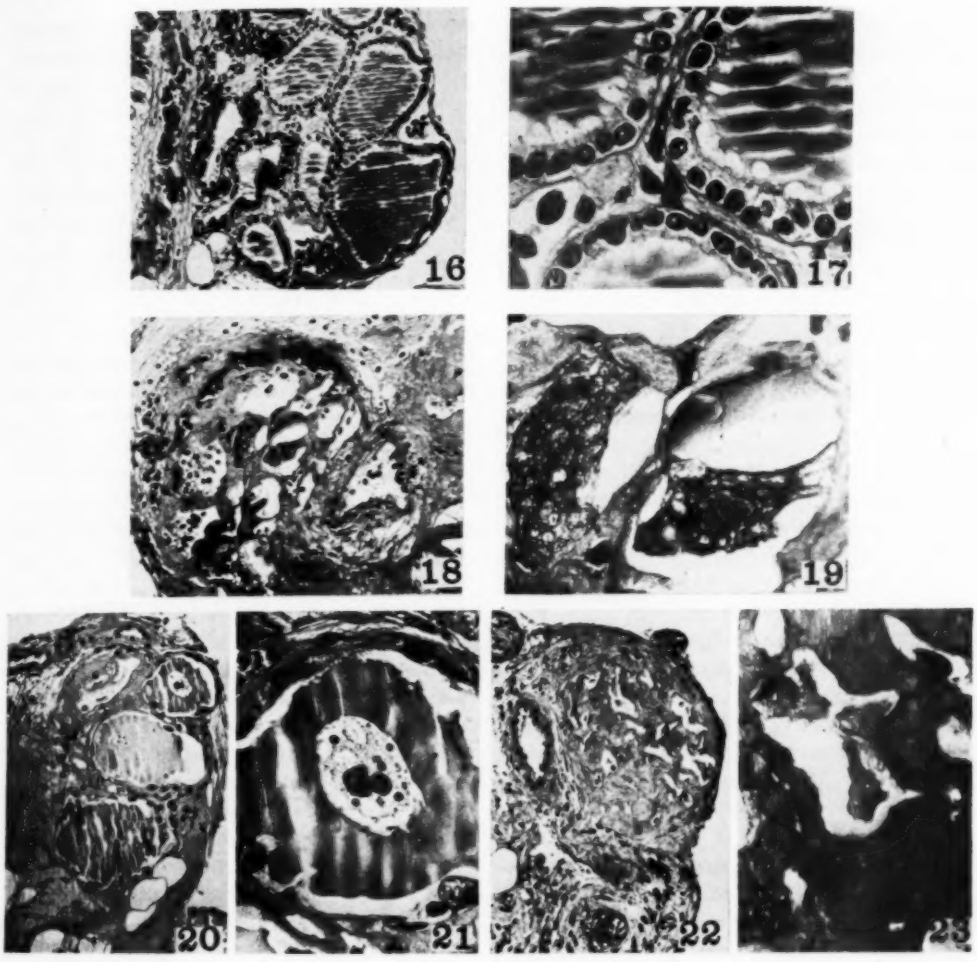


PLATE III

Fig. 16. *Triturus pyrrhogaster* thyroid seven months after thiouracil treatment, showing no residual effect. Compare with Fig. 1.

Fig. 17. Enlarged view of Fig. 16 to show normally active follicular epithelium and colloid resorption.

Fig. 18. Almost complete ablation of thyroid of salamander seven months after single treatment with 25 μc. I^{131}. Great reduction in size. Note hyperemia.

Fig. 19. Enlarged view of segment of Fig. 17 to show abnormal colloid and complete loss of follicular epithelium.

Fig. 20. Thyroid of salamander seven months after I^{131} injection, following thiouracil treatment. Note colloid present but variable, epithelial desquamation, and tendency to fibrosis. Size reduction not as great as in Figs. 18 and 22.

Fig. 21. Enlarged view of Fig. 20 to show epithelial and vascular debris in the colloid and fibrotic changes in the interfollicular tissue. Nevertheless, colloid is present and rather normal in consistency.

Fig. 22. Another specimen showing almost complete failure of pretreatment with thiouracil to give protection against I^{131} damage.

Fig. 23. Enlarged view of segment of Fig. 22 showing extreme fibronecrosis, epithelial-free follicles, and only residual colloid.

that this dose is high enough to be lethal to the rat (Hursh *et al.*, 23).

With regard to the combination of radioiodine and antithyroid compounds, references are made only to the recent papers of Leiter *et al.* (29), Gorbman (18), Goldberg and Chaikoff (15–17), and D'Angelo *et al.* (12). The latter authors found a considerable depression in I^{131} accumulation within two days following treat-

ment of guinea-pigs with propylthiouracil.

The amphibia have not been used very much for this type of investigation, and this in spite of the fact that their glands are most accessible and their cells are among the largest in the animal kingdom. Joel *et al.* (24) did show that immersion in or injection of thiourea caused activation of the thyroid gland in winter frogs, but a continuation of treatment caused an ultimate regression of the gland. Matthews (32) treated summer frogs with 5 mg. of thiouracil daily for five days and found that they took up only 20 per cent of the radioiodine injected, when compared with the controls. Bradley (7) injected 0.5 c.c. of a 10 per cent solution of thiourea into frogs, producing enlargement, hyperemia, and hyperplasia of the thyroid gland. He claimed, however, that this was due to a stimulation and resultant increase in the output of the thyrotropic hormone from the pituitary gland, rather than to a direct effect on the thyroid itself.

Various prothyroid and antithyroid compounds are being tested currently in our laboratory, in conjunction with ionizing radiations. Thiouracil has long been known to have the effect of enlarging the thyroid and making it resistant to iodine uptake and stimulation. The response of the mammalian thyroid to thiouracil is believed to be rapid (a matter of hours), and the effect is transient in that the gland reverts to the normal level of activity rather quickly, unless there is chronic treatment with the thiouracil. This is because the antithyroid substance seems to act directly on the gland rather than through the pituitary control mechanism (as does iodothiouracil), and it is rapidly excreted. Since in our experiments there was probably a slight build-up of the thiouracil effect, through four injections over three weeks, and since the final injection occurred only twenty-four hours before the single I^{131} treatment, and also because the salamanders are low-metabolic cold-blooded animals, the end-result has been that there is some evidence of protection of the thyroid gland against the I^{131} damage that normally occurs. Nevertheless, several variables must be further investigated:

1. *Dose relations:* Certainly 25 μc. of I^{131} is a damaging dose to the thyroid glands of these salamanders, but possibly a total of 40 mg. of thiouracil over three weeks was not near the toxicity level and a higher dose of the antithyroid substance should be used. This dose, however, was effective.
2. *Time relations:* Obviously the thiouracil effect is drastic, but rapid and transient, and the radioiodine acts much more slowly, although as damagingly to the gland. It is possible that chronic post-treatment with thiouracil might be indicated.

It is known that a large portion of the radioiodine is rapidly excreted by animals studied (see Rugh, 38, 39). It seems obvious from these data that the pretreatment with thiouracil does delay the onset of thyroid damage by I^{131} (compare Figs. 6–8 with Figs. 20–23). Apparently the thiouracil, while it does not prevent the passage of iodine (I^{131}) through the thyroid gland, does not permit it to remain there long enough to allow the cells to incur any radiation damage. If one waits long enough (*i.e.*, seven months), the I^{131} effect will be sufficient and be manifest. The question arises, naturally, whether chronic treatment after the I^{131} injection might save the gland or bring it back to normal activity. This is being investigated with amphibian and mammalian material.

SUMMARY AND CONCLUSIONS

1. Thiouracil tends to affect the thyroid gland of *Triturus pyrrhogaster* in a manner similar to the effect demonstrated for mammalian thyroids, enlarging it somewhat and causing it to accumulate opaque colloid. This effect is transient, however, and is totally lost by two months after treatment.

2. Radioiodine (25 μc.) in a single injection has no effect on the thyroid gland of *Triturus pyrrhogaster* in one week but will cause some damage by one month, complete destruction of the follicular epi-

thelium by two months, and hyperemia and extensive fibrosis of the entire gland by seven months.

3. Pretreatment of the salamander with thiouracil will provide some protection of the thyroid against I^{131} damage. Since the thiouracil effect is transient and the effect of I^{131} is relatively slow, the protection by the antithyroid substance is evident but is not always complete. In some cases it may be almost entirely lacking in some of the glands studied seven months after treatment. This suggests that a time-dose relationship may be established whereby the gland will receive greater protection against I^{131} damage by post-treatment with thiouracil. If demonstrable, this could conceivably have some clinical use in those rare instances of excessive or accidental treatment with radioiodine.

4. The anterior pituitary gland reacted to thiouracil by an increase in basophils; to the I^{131} by an excessive proportion of basophils at two months and evidences of degeneration at seven months; to a combination of thiouracil and I^{131} by a minimum of change from the control condition. The anterior pituitary therefore reflected the protective action of pretreatment by thiouracil against I^{131} effects.

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SUMARIO

Modificación con el Tiouracilo de los Efectos del Radioyodo sobre el Tiroides

La droga antiroidea, tiouracilo, fué inyectada en la salamandra *Triturus pyrrhogaster* durante un período de tres semanas antes de la inyección de 25 μc. de radioyodo (I^{131}), en un estudio del posible efecto protector de dicha preterapéutica contra la esperada lesión del tiroides por el radioyodo. Observóse que el tiouracilo, inyectado intraperitonealmente, provocaba una hipertrofia pasajera del tiroides, en el que se acumulaba coloide opaco. Para los dos meses de la inyección, los tiroides se hallan absolutamente normales. En los animales inyectados con radioyodo, no se nota efecto histológico inmediato, pero al cabo de un mes ya hay alguna lesión y a los dos meses destrucción total del epitelio folicular de las glándulas tiroides. A los siete meses, es difícil reconocer éstas debido a la disminución de su tamaño y extensa fibrosis.

El pretratamiento de la salamandra con inyecciones de tiouracilo facilita alguna protección al tiroides contra lesión por el I^{131}. Esta protección es inmediata y transitoria, en tanto que la lesión producida por el radioyodo es lenta y duradera. Esto sugiere el posible valor del tratamiento crónico con tiouracilo después de administrar yodo radioactivo en los casos en que conviene proteger el tiroides contra lesiones excesivas.

Selective Shielding Against Roentgen Radiation[1]

THEODORE J. WANG, PH.D.

SELECTIVE exposure of local areas to roentgen radiation is usually simple to accomplish by blocking off all but the exposed area with sheets of lead. If the volume exposed is relatively small, the radiation which is scattered into the shielded regions is apt to be negligible. On the other hand, selective *shielding* of local areas may be a difficult problem, since in this case the scattering volume is often relatively large. Because of the frequent need for selective shielding in biological work, a study has been made of the contribution of scatter from remote regions to the dose delivered at a particular point in a phantom.

The experimental arrangement is shown in Figure 1. A circular lead shield was mounted atop a Presdwood phantom coaxially with the vertical x-ray beam. By means of a Victoreen thimble ionization chamber, radiation intensities were measured in the center of the beam at two depths within the phantom, namely, 1.6 cm. and 13.6 cm. The phantom was 23.3 cm. deep overall (including a 2.2 cm.-thick supporting maple table top) and 30×30 cm. in cross section. Lead shields of various radii up to 9 cm. were employed. The shields were 1/4 inch in thickness, adequate to stop all but a negligible amount of the incident radiation. The incident radiation (200 kv.p., half-value layer 1.0 mm. Cu) was obtained from a standard Picker Villard-type therapy unit with 0.5 mm. Cu plus 1.0 mm. Al added filter. The radiation beam was not quite symmetric about the central vertical axis but exhibited heel-effect characteristics. The ionization chamber was mounted horizontally in a direction perpendicular to the long axis of the x-ray tube.

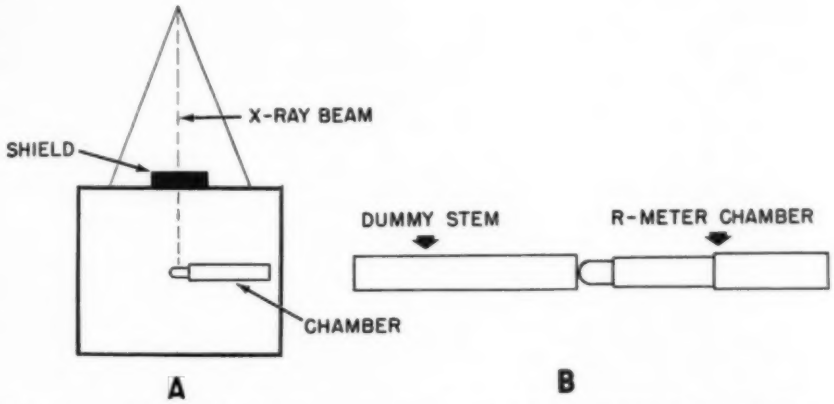

Fig. 1. A. Set-up for scatter study. B. Arrangement of dummy stem to check shielding due to r-meter stem.

Error due to the directional characteristics of the chamber was neglected. Some compensation, however, was provided for the shielding caused by the chamber stem, in that a dummy stem was butted up against the thimble as shown in Figure 1(b), and the reduction in reading was noted when the dummy stem instead of phantom material occupied the space directly ahead of the chamber. This reduction in reading was attributed to

[1] From the National Cancer Institute, Bethesda, Md. Accepted for publication in August 1952.

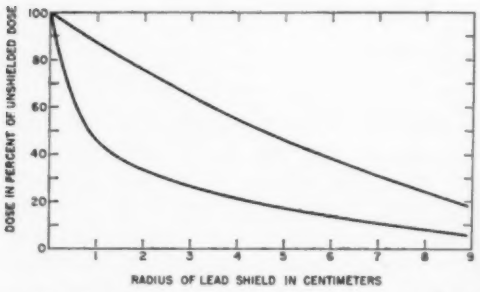

Fig. 2. Contribution of side-scatter to total dose in phantom.

shielding of the radiation from the chamber by the dummy stem and was considered to be equivalent to the shielding error introduced by the regular chamber stem. It is interesting to note that the difference was fairly large, amounting generally to about 15 per cent of the observed (uncorrected) r-meter reading.

The corrected results are shown in the curves of Figure 2. Here the abscissae represent the radii of the lead shields, and the ordinates indicate dose in per cent of unshielded dose. The upper curve is for the point 13.6 cm. below the entrance surface of the phantom, and the lower curve is for the point at 1.6 cm. The curves show the amount of radiation which must be attributed to side-scatter (direct beam and forward scatter being removed by the shield) from portions of the phantom beyond any particular radius. For example, the upper curve indicates that, under the given conditions of radiation quality and phantom geometry, more than half the dose at the point being considered results from side-scatter arising from regions of the phantom at least 4 cm. removed, and about one-fourth of the dose results from radiation scattered at least 8 cm. For points which are closer to the surface of the phantom on the axis of the beam, the contribution from scattering is less. However, at 1.6 cm. depth the lower curve shows about half the total dose coming in from regions at least 1 cm. removed and one-fourth from distances over 3.5 cm.

In this study, wave-length dependence of the chamber was neglected. Any reckoning of degradation of the spectrum on passage through the absorber would lead to even higher values of the relative contribution of scattering from remote regions.

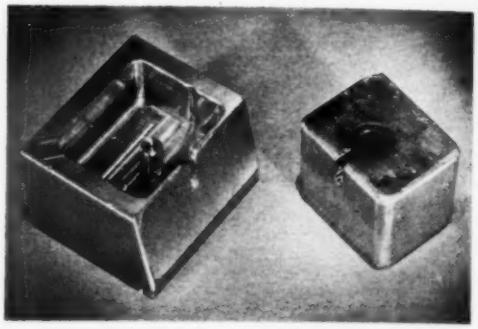

Fig. 3. Ovary shield for mouse. In the left hand view the top is inverted.

A selective shielding that is sometimes employed with small animals is an encircling lead band about the region to be protected. The applicability of such a simple band technic is obviously limited, in view of the foregoing considerations on scattering.

One effective type of selective shield is that which completely encases a mobilized section. An example of such a shield used for protecting a mouse ovary is shown in Figures 3 and 4. The ovary is withdrawn through an incision in the back of the mouse and enclosed within a recessed channel which does not "see" any part of the exposed volume of the mouse. A refinement of this particular shield is a millimeter lining of plastic in the channel holding the ovary, the plastic serving as an absorber of secondary electrons created within the lead. Checks of the effectiveness of this shield were made with a cadmium sulfide probe. Measurement of the dose to the ovary relative to the whole body dose showed it to be less than 0.1 per cent for 200 kv.p. radiation of 1.0 mm. Cu half-value layer.

NOTE: Grateful acknowledgment is made to Dr. Thomas Reid, to Miss Delta Uphoff, and to Mr. Nathan Coffey of the National Cancer Institute for

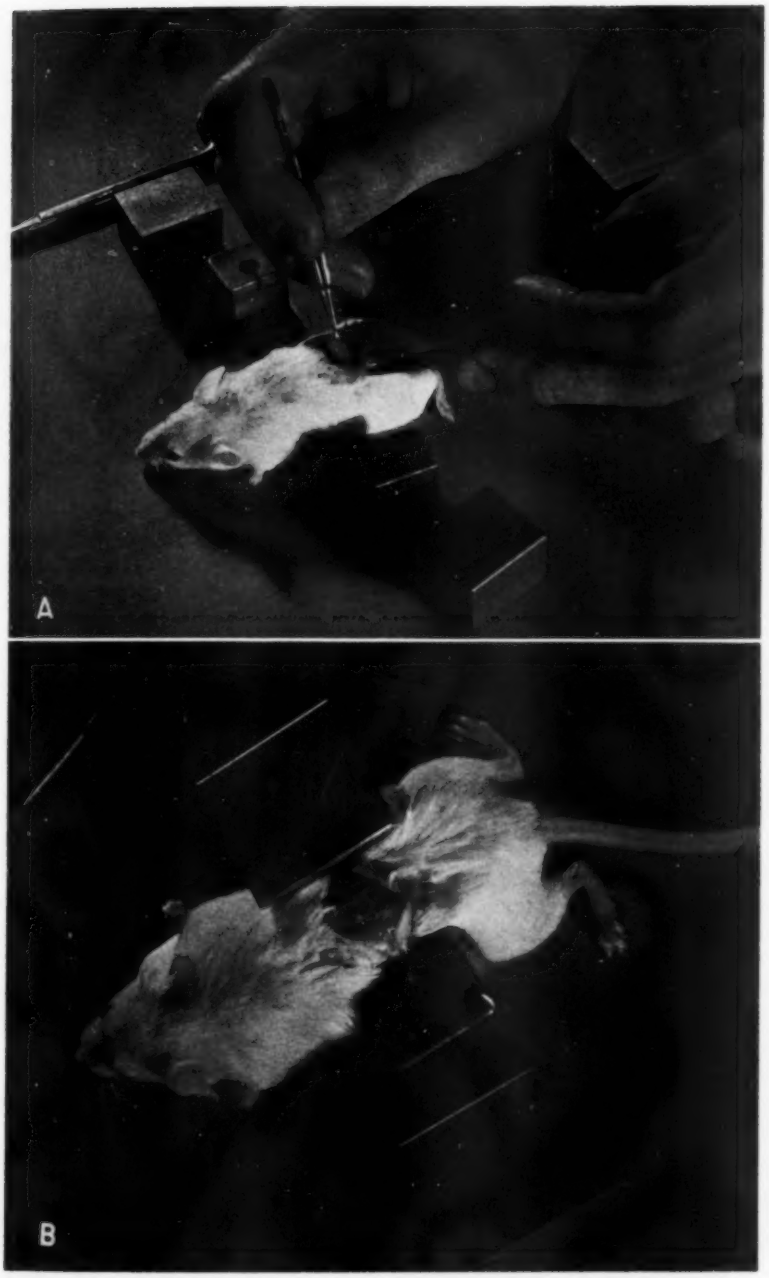

Fig. 4. A. Technic for removal of ovaries. B. Pair of shields in position on mouse (lid in place on one shield, not yet attached on other shield). (Figs. 3 and 4 from the Photographic Research Section, National Institutes of Health.)

assisting with the work. X-ray facilities were kindly provided through arrangements with Col. H. I. Amory of the Army Medical Center, Washington, D. C., and with Mr. Donald O'Connor of the Naval Ordnance Laboratory, White Oaks, Md.

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SUMARIO

El Resguardo Selectivo contra los Rayos X

Dada la frecuencia con que se necesita protección selectiva contra la radiación roentgen en los trabajos biológicos, se llevó a cabo un estudio de la dispersión desde regiones remotas en relación con la dosis entregada en un punto dado en un fantasma. Observóse que, en un punto 13.6 cm. por debajo de la superficie del fantasma, más de la mitad de la dosis se dedía a dispersion lateral procedente de regiones del fantasma alejadas a lo menos 4 cm. y aproximadamente la cuarta parte, de rayos esparcidos a lo menos 8 cm. A 1.6 cm. de la superficie, aproximadamente la mitad de la dosis total procedía de regiones alejadas a los menos 1 cm. y la cuarta parte de distancias de más de 3.5 cm.

Descríbese y reprodúcese una forma eficaz de resguardo selectivo para proteger el ovario del ratón. Consta de un conducto retirado y forrado de una substancia plástica, en el que se encierra el ovario, después de extraerlo por una incisión verificada en el dorso del animal.

A New Device for Radiographic Measurements[1]

HARMON J. MACHANIC, M.D., and BERNARD LIEBERMAN, M.D.

IN THE PAST, nomograms, distortion charts, or mathematical calculations have been required for the accurate roentgenographic determination of object sizes except where precision stereoscopy was employed (1). A method of mensuration recently described by Attwood (2), with particular reference to the femoral neck, uses a modified Thoms grid (3), a rather bulky apparatus and one subject to error in its proper placement.

It was our thought that a more adequate and simpler process might be found. We felt that a film which automatically incorporated a measuring reference having the same distortion as the object to be measured might be of value. Methods now available require the extra step of superimposing the measuring reference by a double exposure. To eliminate this, we turned to laminagraphy (4–7).

The basic principles of the laminagraph were first described in patent specifications by Bocage (8), in 1922, and are well known to every radiologist. The essential feature is the synchronized motion of the tube and film, producing a fairly sharp image of the plane in focus, while blurring the sections anterior and posterior thereto. A complete review of tomographic technic and its history is given by Andrews (9).

It was felt by the authors that the image of a radiopaque ruler included in the plane of the tomographic cut would show the same distortion as a result of the tube-film and object-film distance as would the image of the object to be measured. In practice, employing the device described below, the size of the ruler on the film agrees with the predicted theoretical size as determined by mathematical calculation from the method of similar triangles.

The measuring device or ruler that was finally decided upon consists of copper or silver wires 15 cm. long, spaced 0.5 cm. apart. They are imbedded for rigidity and protection in a thermal-setting plastic such as can be bought in any hobby shop. A stand was devised for holding the ruler against the part to be measured and for raising or lowering it, if necessary, to fit the depth of the part (Fig. 1.)

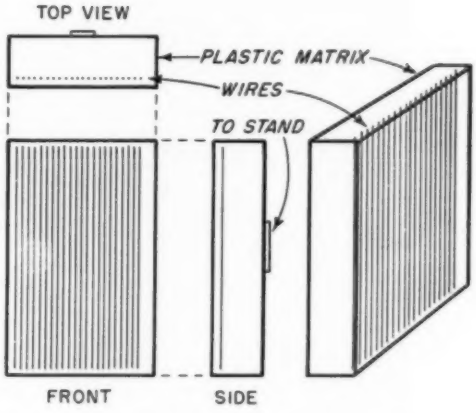

Fig. 1. Drawing showing the placement of the silver or copper wires in plastic. They are parallel and 0.5 cm. apart. At a specific cut they are projected on the film as a series of points. See Fig. 2.

In practice, the patient is positioned with the laminagraphic ruler placed as close to the part to be measured as possible. A cut is taken through the central point as previously determined by right-angle radiographs or, where this is not feasible, by direct measurement from a landmark on the body surface. It has been our practice to take not only this film but further sections 0.5 cm. above and below, to be certain of including the proper plane.

Up to the present time we have employed this system primarily to determine the length of the femoral neck prior to hip nailing and in radiography of the femoral head and acetabulum before a Judet head (10) is chosen.

[1] From the Radiologic Service of Dr. Milton G. Wasch, Jewish Hospital of Brooklyn, Brooklyn, N. Y
Accepted for publication in October 1952.

Fig. 2. Laminagraphic cut through the femoral neck showing the ruler *in situ*. Distance between points represents width between silver (or copper) strips which are 0.5 cm. apart. By applying the ruler (thus obtained) we measure the width of the femoral neck.

Our technic for the above measurement is as follows. The femoral neck is centered to the tube and film, and the ruler is applied at the region of the greater trochanter while the thigh is rotated internally 20 degrees so as to bring the femoral neck parallel to the film (11). Sections are then made at the level of the greater trochanter as well as 0.5 cm. anterior and posterior to this plane. The film which best portrays the femoral neck is then chosen and measurement of the part is made directly from the ruler, which appears as a series of dots (Fig. 2).

This same method can be used in procuring the dimensions of the medullary canal prior to the insertion of an intramedullary nail. Other purposes for which this ruler might be employed to advantage would be in localizing and determining the size of foreign bodies, pulmonary cavities, or tumors. It might also be considered for determining the size of gas-filled chambers in pneumoencephalography.

SUMMARY

A simple method of radiographic measurement of objects is given, involving the use of a laminagraphic ruler consisting of parallel wires embedded in a plastic matrix.

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SUMARIO

Nuevo Método para las Mediciones Radiográficas

Descríbese un método sencillo para la determinación de la posición y la medición de los objetos radiográficamente. Comprende el empleo de la laminagrafía y de una regla radiopaca que va comprendida en la figura laminagráfica, de modo que la imagen de aquélla revela la misma desfiguración, debido a la distancia del tubo-película y objeto-película, que la imagen del objeto que va a medirse. La regla consta de una serie de alambres de cobre o plata de 15 cm. de largo y espaciados 0.5 cm., que están empotrados en plástico. Colocada lo más cerca posible a la parte que va a medirse, aparece en el laminagrama como una serie de puntos. Como se sabe que la distancia entre los puntos representa 0.5 cm., es posible hacer una lectura directa de la medición.

El método ha sido usado principalmente para determinar el largo del cuello y de la cabeza del fémur antes de fijar con clavijas la cadera y de procedimientos artroplásticos. Propónense otras aplicaciones.

Design and Construction of a Simple Applicator for 1,000 Curies of Cobalt 60

RUSSELL H. NEIL, WILLIAM E. COSTOLOW, M.D., and ORVILLE N. MELAND, M.D.[1]

EARLY IN 1948 consideration was given to the design and construction of a Co^{60} applicator to be used in cancer therapy. The mercury plug in the 4-gram radium bomb, which had been designed[2] and used in this institution for the past eleven years, had given no trouble, but a simpler design seemed possible. A general description of the apparatus which was designed by one of us (R.H.N.) will be given, accompanied by a schematic drawing and pictures showing various stages of construction.

The first treatment with the new cobalt applicator was given at the Los Angeles Tumor Institute on April 23, 1952. The patient was a young woman, thirty-four years of age, who was suffering from bronchogenic carcinoma. Since then (as of Oct. 1, 1952) a total of 104 new cases have been admitted for cobalt teletherapy. Thirteen patients with bronchogenic carcinoma have either completed a series of treatments or are now under treatment.

The cobalt teletherapy apparatus has been in constant daily use (except Sundays) since April 23, 1952. No mechanical difficulties have been encountered in the operation of the unit.

GENERAL CONSIDERATIONS

After consideration of various mechanisms for handling radioisotopes in an applicator for treatment purposes, the design finally selected was a long loose-fitting plug with the cobalt attached to the end. This was very easy to construct, as no precise machine work was required. Motors, gears, chains, bearings, and controls were selected from stock readily available to fit the job.

The use of a combined shipper-applicator depends upon making the loading sufficiently simple. The simplicity of the design more than compensates for the extra weight. The second portal is easily provided and will be useful when treatment time becomes very long, near the end of the useful life of the isotope. Treatment distance may be as short as 30 cm., if desired. For testing, small objects were inserted inside the portals, where extremely high radiation fields are available. Scattered radiation at the outer end of the 70 cm., 10×10 cone is less than 5 mr per hour when the cobalt is in safe position. A conical plug for changing the portal size is used to obtain a sharp cut-off of radiation at the edge of the beam. The cone was extended to the patient for two reasons: first, that he might lean against it to assist in keeping a fixed position during treatment and, second, to reduce penumbra to a minimum. The long thick walls with lead attached make a very heavy cone, but change of cones is easily effected by having the spare cones on a movable table at the correct height. It is necessary only to slide one out and the other in. No lifting is required. The flanges are used to bolt the cones to the applicator. Square, round, and rectangular cones of various sizes are available. If desired, a visualizer type of beam-limiting device may be attached in the same manner.

CONSTRUCTION

A 20-inch-diameter cylinder of lead having hemispherical ends is shown in Figure 1. This structure approximates two spheres (partly overlapping) having their centers 11 inches apart. It was made by using a 20-inch diameter cylinder, 11 inches long, and attaching a hemisphere at each end. A 2-inch diameter tube was welded between tapering portals. Figure 1 shows the portals attached to one hemispherical section just before the last weld.

[1] From The Los Angeles Tumor Institute, Los Angeles, Calif. Accepted for publication in October 1952.
[2] See Am. J. Roentgenol. **44**: 117–121, July 1940.

About 3,000 pounds of lead were required to fill the shell. A lead cone (beam-limiting) is shown in one portal with part of the heavy cone wall projecting.

After testing the operating device and the fit in the frame, the applicator-shipper (shield) was placed in a steel crate and shipped to Oak Ridge for loading. This is the largest radioactive source ever produced in the United States for medical use. Shipping weight was 4,400 pounds.

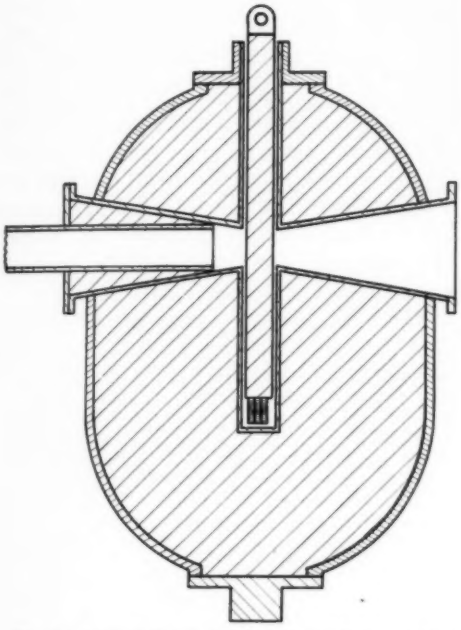

Fig. 1. Schematic drawing showing cobalt in safe position.

Upon its return to Los Angeles Tumor Institute the applicator-shipper was inserted in the frame and hinged to beams on the ceiling of the underground treatment room. This room had been used previously for the 4-gram radium pack and was very conveniently located, but the low ceiling posed a special problem. It was for this reason that the frame was hinged to the support beams, thus allowing the applicator to be lifted very close to the ceiling. The frame (a welded box structure) is rigid and, with two double chains for lifting, becomes extremely safe. A 3-h.p. motor, through two sets of worm gears, provides more than adequate power to hoist the two-ton shield and frame at the required speed. A counter balance relieves the motor of its load and provides an additional safety factor, also reducing to a minimum the wear on the hoist. The support bearings in the frame are such that the heavy shield can be rotated by hand, but a motor drive is provided so that stopping and locking become automatic through the worm reduction gears. The speed of rotation is very slow and overdrive is negligible. Such complete flexibility is not necessary but does make it easier to "set up" patients for treatment.

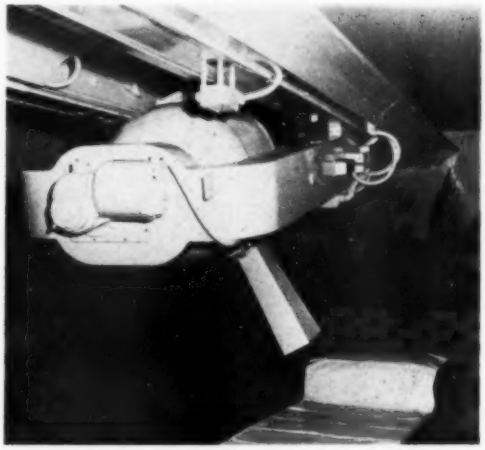

Fig. 2. View of Co^{60} applicator from entrance to room.

Entrance to the treatment room is by way of a maze. The control panel is placed outside, about 20 feet away. Mirrors provide a view of the patient during treatments.

AUTOMATIC OPERATION

A motor is geared to a crank, which is attached to a slide, to move the cobalt from safe to treatment position and return. Limit switches stop the motor at either extreme position. In case of switch failure, all automatic operating electric circuits may be disconnected at the control panel by a switch which then connects the three wires direct from the motor to a hand-operated controller. Hand operation

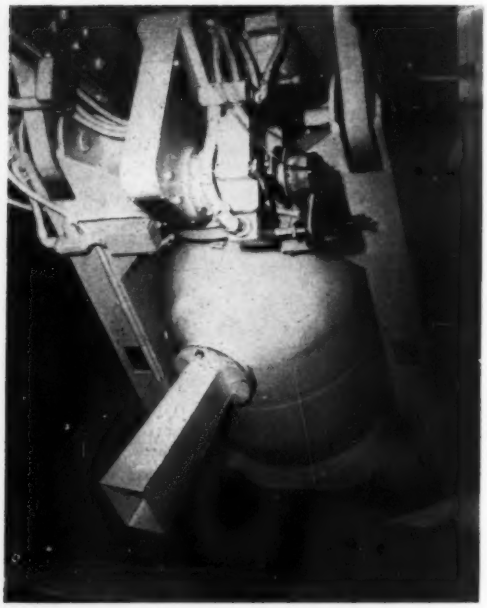

Fig. 3. Patient's view of Co^{60} applicator.

(aided by a position indicator) may be used until it is convenient to repair the automatic switching. All controls are 220-volt and all motors are 3-phase. The slight increase of cost is offset by the greater reliability of 3-phase motors. Magnetic starters are greatly oversize, so that very little service will be required. An independent 3-phase line is provided direct from the main feeders so that other apparatus will not cause unnecessary shut-down. In case of A.C. power failure, a gear shift and hand-operated chain drive can be used (through the ceiling) to return the cobalt to a safe position. In case of a gear failure (extremely remote) a single pin may be released, dropping the cobalt into its safe position.

COBALT 60

The cobalt itself consists of 108 pieces stacked as closely as possible. Six stacks of 18 pieces each form a cylinder 4.33 cm. tall and 3.5 cm. in diameter. The sealed stainless steel tubes holding the cobalt have a wall thickness of about 0.012 inch (240 mg./cm.^{2}). The outer end of each cone has a 0.010-inch brass cover.

From the above dimensions it follows that the 1,080 curies of cobalt occupies 20.42 c.c. and weighs 181.74 gm. (0.4 lb.). On Feb. 25, 1952, it had a specific activity of about 5.94 curies per gram. The measured output on that date was about 32 r per minute at 70 cm.

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SUMARIO

Diseño y Construcción de un Aplicador Sencillo para 1,000 Curies de Cobalto 60

El aparato descrito para teleterapia con cobalto fué construído en el Instituto para Tumores de Los Angeles, California. Remitido a Oak Ridge, Tenn., para introducir allí el cobalto radioactivo, fué devuelto al Instituto y colocado en una rígida armazón unida por goznes a las vigas del cielo raso de un cuarto subterráneo de tratamiento. Hay medios para hacer funcionar el aparato a mano si fracasan los conmutadores automáticos. Todos los reguladores son de 220 voltios y todos los motores de 3 fases.

El aplicador fué émpleado por primera vez para tratamiento el 23 de abril de 1952 y hasta el 1° de octubre de 1952, se habían admitido 104 enfermos para cobaltoteleterapia. No se han encontrado dificultades mecánicas en el funcionamiento del aparato.

Late Effects of Roentgen Irradiation

I. Studies on Rats Irradiated under Anoxic Anoxia[1]

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IN THE FALL OF 1949, studies were carried out on the effect of anoxia on roentgen irradiation injury in rats. At that time it was demonstrated that irradiation under extreme anoxia shifted the LD 50 measured at 30 days from a little over 600 r to over 1,200 r (1). All of the animals from groups irradiated at 1,000 r, 1,200 r, and 1,400 r which survived 30 days were kept for further observation. Because of limited caging space, only a small sampling of the groups irradiated at 600 r and 800 r were kept. As determined by body weight and clinical observation, all of the animals appeared to have recovered at the 30-day period of observation, when such experiments are usually terminated. These animals have now been observed for 540 days.

METHODS AND RESULTS

All of the rats used in this study were from the Wistar strain. The details of the irradiation technics used and the post-irradiation course for the first 30 days are given in an earlier report (1). The procedures used in the present studies were as simple as possible. The rats were kept four to a cage, fed Rockland rat chow, weighed weekly, and observed for any changes. Animals showing marked weight loss or other evidence of disease were sacrificed as they became terminal, and tissues

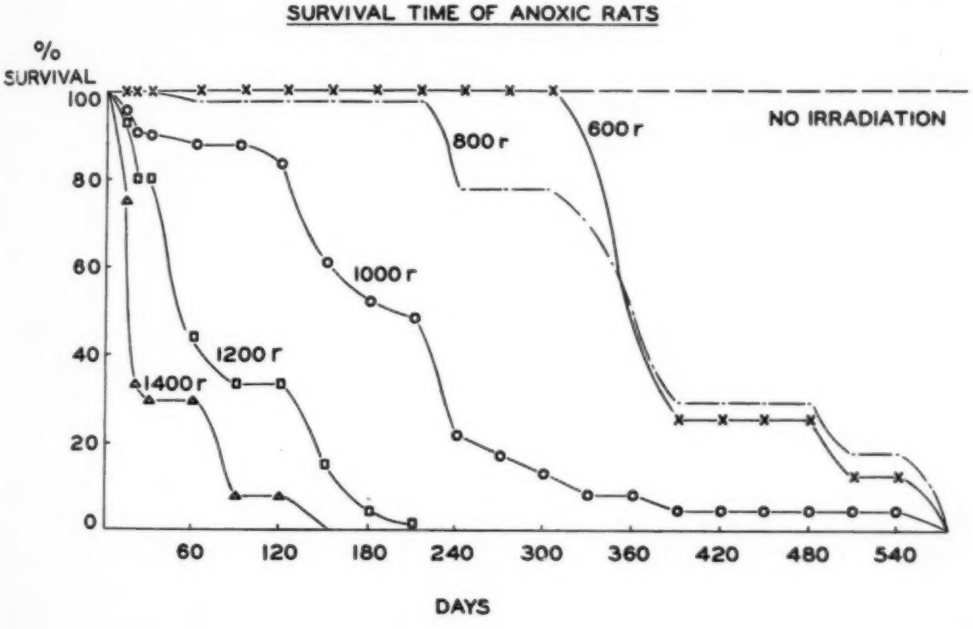

Figure 1

[1] This paper is based on work performed under Contract No. AT-04-1-GEN 12 between the Atomic Energy Commission and the University of California at Los Angeles.

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were taken for histologic examination. Eight unirradiated rats were kept as controls under identical conditions.

The first significant finding was a marked shortening of the life span (Fig. 1). This occurred in spite of the protection furnished by the anoxia against the lethal action of x-rays in the immediate post-irradiation period. Exactly how much the life span was shortened could not be determined, since our colony was new, and we had no data on longevity of normal rats except for the small group of controls included in this experiment. From values found in the literature, the shortening of life span was at least 50 per cent, even in the animals receiving only 800 r (7, 29). Weight curves of four typical animals are shown in Figure 2.

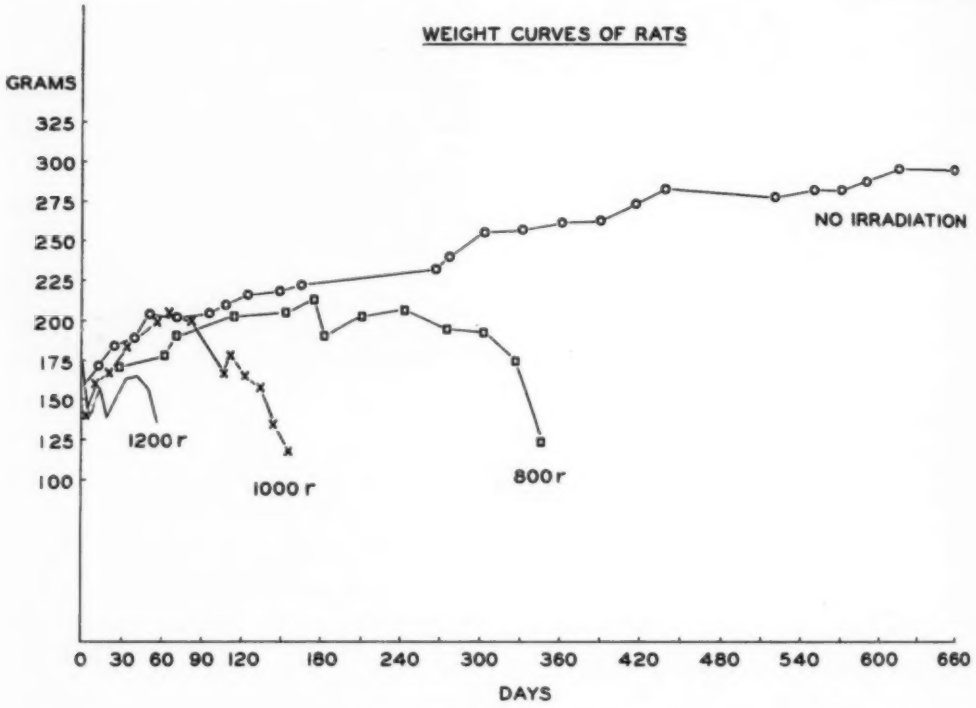

Figure 2

Our clinical and postmortem observations indicate that there were three post-irradiation periods. Period one was from the 30th to approximately the 100th day; the second period was from the 100th to approximately 300 days; and the third period from 300 days to 540 days.

Period I: 30 to 100 days: Respiratory infections developed first in the 1,400 r animals, and then in the 1,200 r animals, progressing into pneumonia. The onset of infection was associated with a rapid and marked weight loss, and death resulted usually within a couple of weeks. Autopsy findings of interest on these animals were chiefly confined to the lungs, where varying degrees of lobar and bronchopneumonia were found. A purulent empyema and pericarditis frequently accompanied the pneumonia. The bone marrow and other tissues were examined and were found to be normal.

Consistent histopathologic findings were limited to the lung. Generally there was a severe patchy bronchopneumonia. Often the pneumonia was limited to the peribronchiolar alveoli, varying in severity from

TABLE I: LATE HEMATOLOGIC CHANGES IN IRRADIATED RATS

Irradiation Dose	Days Post-Irradiation	RBC	Percentage of Reticulocytes	WBC	Platelets
Unirradiated controls*	0	7.7	1.0	16,000	750,000
1,000 r	247	2.99	19	11,700	142,000 120,000
1,000 r	252	3.55	16	11,300	352,000 490,000
1,000 r	248	6.3	7.2	11,000	384,000 262,000
1,000 r	251	3.71	15.2	12,300	320,000 310,000
1,000 r	292	4.47	9.2	16,700	500,000 440,000
1,000 r	188	2.78	30.0	9,150	628,000 568,000
1,000 r	255	3.55	8.4	19,750	244,000 268,000
1,000 r	98	6.13	5	12,300	400,000 304,000
800 r	383	4.61	6	5,000	102,000 94,000
800 r	383	4.97	20	20,400	374,000 344,000
800 r	387	1.81	35	10,100	248,000 238,000

* Average value for 32 animals.

simple inflammatory infiltration to frank suppuration with large granuloma-like abscesses. In addition to the pneumonia, most of the animals showed irregular nodular zones of consolidation in which intact alveoli were packed with large round cells resembling macrophages. These round cells contained one and occasionally two centrally placed nuclei; their cytoplasm was abundant, foamy, and pale, but had distinct contours.

The 600 r, 800 r, and 1,000 r animals, with the exception of a few in the 1,000 r group which developed pneumonia, remained well and gained weight during this period.

Period II: 100 to 300 days: In the second period there were a few deaths due to pneumonia; many of the deaths seen in this period, however, were in the 1,000 r group and were associated with gradual weight loss and progressive anemia. Investigation showed a reduction of platelets to 50 to 80 per cent below normal values. In some rats, the erythrocytes were as low as 2.0 million per cubic millimeter, while reticulocytes were increased from a normal of 1 per cent to values up to 35 per cent. The neutrophil counts were normal (Table I).

Bone-marrow studies showed a hyperplastic marrow which contained erythroid and myeloid cells in all stages of development and many megakaryocytes. Microscopic examination of the other tissues failed to reveal evidence of significant extramedullary erythropoiesis.

Because of the morphologically normal marrow and the increased percentage of reticulocytes in the peripheral blood, the most likely cause of the anemia appeared to be erythrocyte destruction. The low platelet count suggested that an abnormally functioning spleen might be involved (2, 3), and since this could explain both the thrombocytopenia and an excessive destruction of erythrocytes, it was investigated further.

Splenectomy was attempted on several animals in this group, but due to the generally weakened condition of the rats with severe anemia none survived surgery. As a result, the role of excess erythrocyte destruction could not be evaluated. In 4 animals with early thrombocytopenia, splenectomy was successful and the platelets rose within three days from 50 per cent below normal to 100 per cent above normal, and remained at this high level as long

TABLE II: EFFECT OF SPLENECTOMY ON LATE HEMATOLOGIC CHANGES

Days Post-Irradiation	RBC	Percentage of Reticulocytes	WBC	Platelets
Rat No. 43: *1,000 r*				
30	6.20	0.8	12,750	714,000
72	7.02	1.5	18,650	390,000
170	5.64	5.0	13,050	368,000
175		*Splenectomized*		
182	4.39	13.0	20,450	1,182,000
				1,632,000
Rat No. 87: *1,000 r*				
35	7.88	0.8	7,600	712,000
				794,000
56	8.52	4.0	10,350	736,000
				790,000
167	7.73	2.0	18,400	516,000
365	7.44	2.0	27,500	262,000
				358,000
366		*Splenectomized*		
369	8.46	2.5	20,000	1,130,000
				1,104,000
398	8.17	5.0	22,300	1,056,000
				1,120,000
Rat No. 4: *800 r*				
382	4.89	12.0	10,900	448,000
				350,000
382		*Splenectomized*		
385	2.10	30.0	11,950	1,838,000
				1,400,000
Rat No. 40: *800 r*				
375	4.61	6.0	11,150	328,000
380		*Splenectomized*		
383	4.00	11.0	14,150	800,000
400	4.59	14.0	7,600	1,290,000
				1,084,000

as the animals survived (Table II). No significant histologic changes were present in the spleen, although the spleens were grossly enlarged.

A consistent postmortem finding in the animals during this period was the presence of brown granular kidneys which on histologic examination exhibited a marked nephrosclerosis. The glomeruli showed varying degrees of fibrous and hyaline degeneration, and there was corresponding atrophy of their associated tubules. The intact tubules were dilated and frequently contained hyaline casts.

The arterioles of the kidney and occasionally the arterioles in the remaining viscera showed thickened walls and narrowed lumina. This vascular thickening was due chiefly to medial hyperplasia. Although the internal elastic membrane appeared slightly frayed in a few instances, there was no distinct splitting or reduplication, and in none of the vessels examined was there necrosis of the media.

After the arterial and kidney changes were observed, blood pressure measurements were made on a group of animals irradiated at 1,000 r under anoxia 300 days before and compared with those of non-irradiated animals of the same age. Systolic blood pressure measurements were made by the tail cuff method under light ether anesthesia. While this method has limitations, all the findings in Table III were checked by two observers. The marked difference between irradiated and non-irradiated animals of the same age is certainly greater than the error in the method.

TABLE III: BLOOD PRESSURE IN ANIMALS IRRADIATED UNDER ANOXIA AND NON-IRRADIATED CONTROLS

Rat Number	Blood Pressure Rats Irradiated with 1,000 r	Blood Pressure Control Rats
1	138	93
2	152	100
3	133	100
4	150	102
5	145	100
6		96

In an attempt to determine whether anoxia or irradiation was most important in producing the elevation in blood pressure, a group of rats irradiated without anoxia 270 days before with 500 r were studied. The results are shown in Table IV.

Since animals 5, 6, 7, and 10 in Table IV show definite increases in blood pressure, it would appear that this effect can be produced without anoxia, and that the more severe hypertension seen in the 1,000 r animals was the result of the higher roentgen dosage. The anoxia at the time of irradiation merely protected the animals from the acute lethal effects, allowing them to survive into the period where hypertension develops.

During this period and the later period (over 300 days) the adrenals were frequently found to have a mottled dark gray

TABLE IV: BLOOD PRESSURE IN RATS IRRADIATED WITHOUT ANOXIA

Rat Number	Blood Pressure 500 r Rats
1	104
2	100
3	96
4	96
5	120
6	144
7	118
8	106
9	106
10	120

color with small dark areas suggestive of hemorrhage and scarring. Microscopically these showed fresh hemorrhages in the capsule and outer zone of the cortex. These were interpreted as agonal changes.

Period III: 300 to 540 days: Only the 600 r, 800 r, and a few 1,000 r rats survived to this period. The changes seen in these animals were gradual weight loss; development of cataracts, which on microscopic examination revealed nucleated and non-nucleated "balloon cells" and granular debris in the lens similar to those described by Cogan *et al.* (32); subcutaneous tumors, chiefly adenofibromas; a marked epilation over the head and back, which appeared too late to be a direct effect of radiation. The kidney and blood changes seen in the previous period were also present in most of these animals.

The brain was not examined in the animals sacrificed during the first part of this study. In some of the later animals, however, there was definite evidence of large cerebral and cerebellar hemorrhages. In some cases hemorrhage was seen only when the brain was cut. Histologic examination showed areas of focal hemorrhage with phagocytosis of red blood cells and areas of encephalomalacia. A more careful investigation might have shown this to be a frequent cause of death in the later part of Period II and in Period III.

Heart sections were examined throughout the study. In only one instance was histological evidence of damage found. This consisted of a local aggregation of macrophages filled with hemosiderin. Heart weights were not determined until late in the experiment. In every instance the heart was enlarged as compared with non-irradiated animals of comparable age or weight. This is consistent with the findings of other workers who have studied hypertension in rats (4).

DISCUSSION

The high incidence of deaths due to pneumonia in the higher dose animals was not surprising, since it has been known for many years that the immunity mechanisms are markedly impaired for a period of 30 days and possibly much longer by x-irradiation (5, 6).

The shortening of the life span is hard to evaluate since, according to McCay (7), most rats die of respiratory diseases during their second and third year, which is actually middle age. Very few laboratory rats live to truly old age, which is approximately three and a half years. It matters little in the present situation, however, whether the life span is assumed to be two and a half or three and a half years, since in our irradiated animals it fell short of both figures and of the figure for their own controls. Senility was definitely produced in animals less than two years old.

Late anemias, neutropenias, and thrombocytopenias following irradiation have been described previously. These have usually been referred to as "aplastic" anemias. A review of the literature frequently referred to (8, 20) reveals that this diagnosis has usually been made on the basis of peripheral blood findings. In many cases no bone-marrow studies were made. Actually, in the cases where the marrow has been studied it has frequently been found to be hyperplastic (17, 19). In many cases of radium poisoning carefully studied by Martland (17) there was a hyperplastic marrow associated with an aplastic blood picture.

The confusion of terminology seems to have arisen from a failure to distinguish clearly between the acute post-irradiation anemias, thrombocytopenias, and leukopenias which are associated with markedly hypoplastic marrow, on the one hand, and

the late hypocythemias which may occur months or years after acute irradiation or during the course of chronic irradiation, on the other. In these latter instances the marrow is frequently normal or hyperplastic. Since the same morphologic blood picture may result from entirely different processes in the marrow, it would appear that more than one mechanism may be involved and that the present terminology of aplastic anemia is inadequate.

In recent years another syndrome based on a very similar peripheral blood picture and normal or hyperplastic marrow has been described as hypersplenism. This syndrome has been interpreted as an overactivity of the spleen which may act by the production of a splenic hormone that suppresses the release of cells from the marrow (Dameshek, 2) or by the abnormally rapid removal of cellular elements from the blood (Doan, 3). In certain cases splenectomy rapidly corrects the peripheral blood defect.

In our experiments the blood dyscrasia was only partially studied because of the poor condition of many of the rats. In the animals studied there was no evidence of bone marrow impairment as indicated by the normal white blood count and high rate of reticulocyte formation. Histologically the marrow spaces were packed with cells including many megakaryocytes. Following splenectomy there was a rapid recovery of platelet levels. Thus in every case where splenectomy was surgically satisfactory the hematologic response as described above is consistent with the tentative diagnosis of hypersplenism according to the criteria of Dameshek (2) or Doan (3).

Whether this apparently abnormal splenic function is peculiar to the special situation of this experiment or is possibly a frequent late effect of irradiation is a question which remains to be answered. Two other reports suggest that it may be fairly common. Da Silva Mello (21) reported that after sublethal doses of thorium to rabbits there was a clinically long-standing leukopenia and anemia, and at autopsy these animals had a hyperplastic marrow. The spleen was pigmented and this he attributed to a hyperconsumption of erythrocytes. In the six cases of radium poisoning in human beings carefully studied by Martland, there were also hyperplastic marrows, enlarged spleens, and hypocythemia.

The possibility must also be considered that some of the hypocythemias occurring during the course of radiation therapy for such diseases as lymphatic leukemia and Hodgkin's disease are due to irradiation rather than to the primary condition. Too little is known at present about the late anemias of irradiation to establish sound criteria for late irradiation damage to the marrow and thus rule out irradiation as an etiological agent in the anemias which occur during therapy. The whole problem requires considerably more clinical and experimental data, as well as a clarifying of terminology.

Because of the frequent analogy made between irradiation injury and benzol poisoning, it seems appropriate to point out that Mallory, Gall, and Brickley (23) and Erf and Rhoads (22) have attacked the same confusion of terminology. At least, half of their patients with aplastic anemia due to benzol had hyperplastic marrows. Thompson, in his study of aplastic anemia, pointed out that bone-marrow studies frequently fail to support the diagnosis (19).

Severe arteriosclerosis, nephrosclerosis, and hypertension produced by roentgen irradiation was first reported by Hartman, Bolliger, and Doub (24). In their experiments dogs were given large doses of x-rays to the kidneys and several months later hypertension could be demonstrated. These observations were confirmed by Page (25). Dean and Abels (26) reported the case of a young woman who developed hypertension following large doses of roentgen radiation to one kidney. The hypertension was reversed by removal of the markedly sclerotic kidney.

The spontaneous occurrence of severe arteriosclerosis and nephrosclerosis is unusual in rats less than two years old (29). However, nephrosclerotic lesions very simi-

lar to those described in this study have been observed following the sublethal injection of polonium (31). These sclerotic changes have not been previously reported following roentgen irradiation. This may be due to the fact that in the present experiments two new factors are involved: (1) the combination of roentgen irradiation and extreme anoxia; (2) late observations on animals receiving 800 to 1,200 r whole-body irradiation as a single dose.

Occasional spontaneous pyelonephritis and focal interstitial nephritis are known to occur in this species, and it may be that the hypertensive and arteriosclerotic changes in the irradiated animals are sequelae of such a process. The high incidence of these changes in the irradiated animals, however, and their absence in the control group clearly demonstrate a relationship to the irradiation. Further studies are at present under way to elucidate the mechanism of this response.

The importance of the brief anoxia at the time of irradiation must still be determined. The little evidence which is available suggests that it is of secondary importance. Tissue sections on one animal that received 600 r under anoxia failed to show nephrosclerotic or arteriosclerotic changes at 347 days, while 4 out of 10 animals irradiated with 500 r in air showed early hypertension at 247 days. This would seem to indicate that at 500 to 600 r rats may develop varying degrees of hypertension and sclerosis independent of anoxia. Since every animal receiving 800 to 1,200 r which survived over 100 days showed kidney changes, it would appear that roentgen dosage is more important than anoxia.

The pattern of the present syndrome is remarkable in that there is no acute hypertension as in procedures which interfere with the renal blood supply (*e. g.*, Goldblatt clamp, endocrine kidney of Selye) or where large amounts of DOCA or anterior pituitary are administered (27, 28, 30). Animals receiving 1,000 r under anoxia look like normal healthy rats from 30 days to over 100 days. None of the animals dying in this period show renal or other sclerosis. In animals from another experiment, blood pressure was measured 60 days after irradiation with 1,000 r and was found to be normal in all. Thus, a picture of severe injury followed by apparent complete recovery, a latent period of good health, a gradual onset of arteriosclerosis, nephrosclerosis, and hypertension, and finally, in those animals surviving for approximately a year or so, a high possibility of death due to cerebral vascular accident or renal insufficiency constitutes the syndrome we have produced.

This subtle transition from apparent good health to arteriosclerosis and hypertension is close to the pattern seen in spontaneous hypertension in man, and suggests that this process might be developed into a useful method for the study of hypertension.

The arterial and arteriolar sclerosis observed in these animals differs slightly from that in man, in that there is virtually no participation by the intima in this process. It may be that this is attributable to the marked differences in cholesterol and lipoid metabolism between man and rats. This absence of intimal lesions has also been noted in studies on spontaneous cardiovascular disease in rats (29). Special stains (Masson trichrome and Weigert-Van Gieson) reveal that the medial thickening is, except for a few rare instances, a muscular hyperplasia and not a degenerative change. The absence of any medial necrosis is consistent with the relatively slow development of hypertensive changes.

No carcinomas or leukemias were encountered. The only tumors found were a few benign subcutaneous adenofibromas. Since malignant disease is such a frequent late effect of irradiation injury, its absence in the present study may have been influenced by the strain of rats used.

SUMMARY

Late effects have been studied in rats receiving 600 to 1,400 r whole-body roentgen irradiation under anoxia and surviving the acute post-irradiation period.

The findings were:

1. Marked shortening of the life span.
2. A high death rate due to pneumonia with a rather specific cell type in the granuloma.
3. Nephrosclerosis and generalized arteriosclerosis.
4. Hypertension.
5. A blood dyscrasia characterized by thrombocytopenia and anemia.
6. Cataracts in the animals surviving ten months or more.
7. General cachexia.
8. Late epilation over head and back.

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SUMARIO

Efectos Tardíos de la Irradiación Roentgen: Estudio de las Ratas Irradiadas bajo Anoxia Anóxica

Estudiáronse los efectos tardíos en ratas que recibieron 600 a 1,400 r de rayos X administrados a todo el cuerpo bajo anoxia y que sobrevivieron el período inmediato de post-irradiación. Los hallazgos fueron: (1) notable acortamiento de la duración de la vida; (2) mortalidad elevada debida a neumonía con una forma bastante específica de células en el granuloma; (3) nefrosclerosis y arteriosclerosis generalizada; (4) hipertensión; (5) hemodiscrasia caracterizada por trombocitopenia y anemia; (6) cataratas en los animales que sobrevivieron diez meses; (7) caquexia general; (8) depilación tardía en la cabeza y el dorso.

EDITORIAL

Invitation to the Annual Meeting

The Thirty-ninth Annual Meeting of the Radiological Society of North America will be held at the Palmer House, Chicago, Dec. 13 to 18, 1953. As your President, and on behalf of the officers and members of the many committees who are attempting to make this session a particularly successful one, I extend to you a most cordial invitation to attend.

The Program Committee has arranged a well rounded and diversified program that should appeal to every member of the Society. The Refresher Courses, beginning Sunday afternoon and evening and continuing daily from 8:30 to 10:00 A.M., have become an interesting and indispensable part of our annual meeting. Dr. John W. Walker, and his committee, who have these courses in charge, are rearranging them and introducing some new subjects. In addition, Dr. Edith H. Quimby, of Columbia University, has prepared Refresher Courses on "Therapeutic and Experimental Radiology" that should be of interest to all.

The Scientific Sessions will be conducted in three sections. Section A, Diagnostic Radiology, running concurrently with Section B, which has been arranged by Dr. Lauriston S. Taylor, of the Bureau of Standards, Washington, D. C., in the interests of radiologist, physicist, and biologist.

Section A-B will deal essentially with therapy except on Monday afternoon, when a program devoted to "The Chest" will be presented. The scientific sessions will begin each morning at 10:30 and close at 12:30 P.M. The afternoon session will begin at 2:00 P.M. and close at 4:30 P.M., except on Friday, when the meeting will come to a close at 1:00 P.M.

The annual "Carman Lecture" will be given Tuesday evening by Roger A. Harvey, M.D., on "Atomic Medicine."

Business meetings of the Society will be held Monday, Tuesday, and Thursday afternoons. Time has been set aside for these meetings to give ample opportunity to conduct the important business of the Society without interfering with the rest of the program.

Mrs. John H. Gilmore, as chairman of the Ladies Committee, has arranged an excellent and varied program. The annual banquet will be held Thursday evening. Appropriate entertainment will be a feature, and the occasion will be such that all will wish to attend.

From the standpoint of convenience of transportation, Chicago is a most satisfactory meeting place. The Palmer House has the necessary hotel facilities to care for the scientific and technical exhibits and excellent rooms are available for the Refresher Courses.

We hope you can be with us in December 1953.

IRA H. LOCKWOOD, M. D., *President*

ANNOUNCEMENTS AND BOOK REVIEWS

NASSAU RADIOLOGICAL SOCIETY

The Nassau Radiological Society (Nassau County, N. Y.) has elected the following officers for the ensuing year: President, Dr. James C. Barnett, of Hicksville; Vice-President, Dr. Samuel Herstone, of Bay Shore; Secretary, Dr. Frank Huber, 131 Fulton Ave., Hempstead; Treasurer, Dr. Benjamin M. Stein, of Hempstead.

WISCONSIN RADIOLOGICAL SOCIETY

The annual meeting of the Wisconsin Radiological Society was held in Beloit, May 23, with Dr. S. H. Squire of Chicago as guest speaker. His subject was "Cerebral Angiography." Officers elected at the meeting are President-Elect, Dr. Irving I. Cowan, Milwaukee; President, Dr. R. L. Troup, Green Bay; Secretary-Treasurer, Dr. Wm. W. Moir, 309 Geele Ave., Sheboygan. The following Directors were chosen: Dr. Ralph Frank, Eau Claire; Dr. L. W. Paul, Madison; Dr. F. R. Wilson, Beloit; Dr. H. H. Wright, Milwaukee.

THE PROFESSIONAL BUREAU AMERICAN COLLEGE OF RADIOLOGY

The Professional Bureau, a placement service for radiology residents, sponsored by the American College of Radiology, invites all men in their last year of residency to register with the Bureau six to eight months prior to the termination of their service. Upon registration, they will receive a listing of all positions, assistantships, practices for sale, and locations for radiologists, on file at that time. In addition, their names will be put on the Bureau mailing list so that they will receive announcements of all subsequent requests for radiologists. *No charge will be made for any services rendered to either the registrant or the employer.* All senior residents who are eligible for the examinations by the American Board of Radiology are also eligible for registration with the Bureau. A biographical data blank for the purpose of registering may be obtained by wiring or writing to Dr. S. W. Donaldson, Director, Professional Bureau, 326 N. Ingalls St., Ann Arbor, Mich.

MEDICAL RESEARCH FELLOWSHIPS

The Division of Medical Sciences of the National Research Council is accepting applications for postdoctoral research fellowships for 1954–55. These awards are designed to offer research experience for promising individuals who look forward to investigative careers, and not to provide practical experience in the clinical field. Ordinarily Fellowships are not granted to persons over thirty-five years of age. The following programs are announced:

Fellowships in Cancer Research, available for study in all branches of the biological, chemical, and physical sciences and of clinical investigation applicable to the study of growth, typical or malignant.

British-American Exchange Fellowships in Cancer Research, offered to citizens of the United States for advanced study in Great Britain in specialized fields pertaining to the problem of cancer.

Fellowships in the Medical Sciences, in particular the basic medical sciences.

Fellowships in Tuberculosis, designed to promote the development of investigations in fields related to that disease.

Fellowships in Radiological Research. The Picker Foundation, which supports these fellowships, has expressed particular interest in candidates who propose to carry on research oriented toward the diagnostic aspects of radiology.

Applications for 1954–55 under any of these programs must be postmarked on or before Dec. 10, 1953. Fellowships are awarded in the late winter or early spring. Complete details and application blanks may be obtained from the Fellowship Office, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C.

JAMES PICKER FOUNDATION AWARDS IN RADIOLOGICAL RESEARCH

On behalf of the James Picker Foundation, the National Research Council announces the continued availability of funds in support of radiological research.

Grants-in-aid are designed to encourage research offering promise of improvement in radiological methods of diagnosis or treatment of disease. Applications for the fiscal year 1954–55 must be submitted on or before Nov. 30, 1953.

Grants for Scholars are a transitional form of support, designed to bridge the gap between the completion of fellowship training and the period when the young scientist has thoroughly demonstrated his competence as an independent investigator. A grant of $6,000 per year will be made directly to the Scholar's institution as a contribution toward his support, or his research, or both. Initial grants are limited to one year, but renewal may be recommended. Applications for 1954–55 should be submitted by the institution on behalf of the candidate prior to Dec. 31, 1953.

Fellowships in Radiological Research, available under the program of the Foundation, are described in the preceding announcement.

Further details and application blanks may be obtained from the Division of Medical Sciences, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C.

U. S. ATOMIC ENERGY COMMISSION

The Isotopes Division, U. S. Atomic Energy Commission, Oak Ridge, Tenn., announces a reorganization of its technical staff. The Isotopes Division is the AEC unit responsible for the national and international distribution of stable and radioactive isotopes. Under the new set-up, the Division will consist of three major branches.

The Allocations Branch will review and act upon all applications for isotopic materials. The Radiological Safety Branch will assist radioisotope users in matters of health protection, and the Technical Developments Branch will be responsible for preparing and disseminating information on isotope utilization and for outlining and encouraging training in isotope technics.

Key personnel of the Division are: Paul C. Aebersold, Director; Charles E. Crompton, Assistant Director; Stephen P. Cobb, Jr., Technical Assistant to the Director; James R. Mason, Chief, Allocations Branch; G. W. Morgan, Chief, Radiological Safety Branch; Edwin A. Wiggin, Chief, Technical Developments Branch.

The Commission also announces the merging of two advisory committees—the Reactor Safeguard Committee and the Industrial Committee on Reactor Location Problems—to form a new group known as the Advisory Committee on Reactor Safeguards. The new committee will have the following functions: "(1) Reviewing hazards summary reports prepared by organizations planning to build or operate reactor facilities, including criticality experiments; (2) Advising the AEC regarding the consistency of proposed reactor locations with accepted industrial safety standards, taking into account the proposed exclusion areas for reactors and the proximity of surrounding population and property." The chairman of the Committee is Dr. C. Rogers McCullough, of the Monsanto Chemical Co.

RADIOISOTOPE RESEARCH

The series of basic courses in the technic of using radioisotopes in research continues to be offered at regular intervals by the Special Training Division of the Oak Ridge Institute of Nuclear Studies. Starting dates of the next three courses are Jan. 4, Feb. 8, and March 15, 1954. Applications and supporting letters must be received *three months* in advance of the starting date.

The courses, each of four weeks duration, are especially designed for university faculty members, group leaders of research teams, and other individuals who will impart the training to additional persons.

Applications and additional information may be obtained from the Special Training Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tenn.

NEW CHIEF OF NBS NUCLEONIC INSTRUMENTATION SECTION

Announcement has been made of the appointment of Louis Costrell as Chief of the National Bureau of Standards Nucleonic Instrumentation Section. As Section Chief, he is responsible for the development and construction of special instruments for nuclear measurements and for new developments in the nucleonic instrumentation field.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

SLIPPED CAPITAL FEMORAL EPIPHYSIS. By ARMIN KLEIN, M. D., ROBERT J. JOPLIN, M. D., JOHN A. REIDY, M. D., AND JOSEPH HANELIN, M. D., Massachusetts General Hospital, Boston, Mass. A Monograph in American Lectures in Roentgen Diagnosis, edited by Aubrey O. Hampton, M. D., Chief, Department of Radiology, Garfield Memorial Hospital, Washington, D. C. A volume of 130 pages, with 230 illustrations. Published by Charles C Thomas, Springfield, Ill., 1953. Price $6.75.

A HANDBOOK OF RADIOTHERAPY. By WALTER M. LEVITT, M. D., F.R.C.P. (Lond.), F.F.R., D.M.R.E. (Camb.) of Lincoln's Inn, Barrister-at-Law. Associate Physician to the Department of Radiotherapy, St. Bartholomew's Hospital, London; late Physician in Charge, Department of Radiotherapy, St. George's Hospital; late Examiner in Radiotherapy for the Fellowship, Faculty of Radiologists; and Lecturer in Radiotherapy for the D.M.R.E., Cambridge. A volume of 232 pages, with 53 figures. Published by Paul B. Hoeber, Inc., 49 E. 33rd St., New York 16, N. Y., 1953. Price $6.50.

COPYING AND DUPLICATING MEDICAL SUBJECTS AND RADIOGRAPHS. By H. LOU GIBSON, Technical Editor, Eastman Kodak Company, Rochester, N. Y. A Monograph in American Lectures in Medical Photography, edited by Ralph P. Creer, F.R.P.S., F.B.P.A. A volume of 76 pages, with 37 illustrations. Published by Charles C Thomas, Springfield, Ill., 1953. Price $5.00.

PRACTICAL X-RAY TREATMENT. By ARTHUR W. ERSKINE, M.D. A volume of 196 pages, with 20 illustrations. Published by the Bruce Publishing Co., 2642 University Ave., St. Paul 14, Minn., 4th ed., revised and enlarged, 1953. Price $5.00.

ANNUAL REPORT ON THE RESULTS OF TREATMENT IN CARCINOMA OF THE UTERUS (Previously: Annual Report on the Results of Radiotherapy in Carcinoma of the Uterine Cervix). Eighth Volume. Statements of Results Obtained in 1946 and Previous Years (collated in 1952). Sponsored by the American Cancer Society, British Empire Cancer Campaign, Cancerföreningen, Stockholm, Damon Runyon Memorial Fund, New York, Landsforeningen mot Kreft, Oslo, and National Cancer Institute of Canada. Editorial Committee: Dr. J. HEYMAN (EDITOR), Stockholm, Dr. JOE V. MEIGS, Boston, Dr. M. DONALDSON, London, and PHIL. DR. C.-O. SEGERDAHL, Stockholm. Copies of Volumes I–VIII of the Report may be obtained on application to The Editorial Office, Annual Report, Radiumhemmet, Stockholm 60.

THE MEDICAL ANNUAL. A YEAR BOOK OF TREATMENT AND PRACTITIONERS' INDEX. Editors: SIR HENRY TIDY, K.B.E., M.A., M.D. (Oxon), F.R.C.P., and A. RENDLE SHORT, M. D., B. S., B.Sc., F.R.C.S. A volume of 532 pages. Published by John Wright & Sons, Ltd., Bristol, and Simpkin Marshall, Ltd., London, 1953.

LE OSSIFICAZIONI E LE CALCIFICAZIONI PACHIMENINGEE RETROSELLARI (Quadro radiologico, reperto anatomico, criteri interpretativi). By G. LISCHI, Aiuto, AND A. NERLI, Assistente, Istituto di Radiologia e Terapia Fisica dell'Università di Pisa (Direttore: Prof. Luigi Duranti). A monograph of 76 pages, with 42 illustrations. Edizioni Minerva Medica, Torino, 1953.

BRONCHIAALBOOM, SEGMENTEN EN BLOEDVATEN VAN DE LONG MET HUN VARIATIES. The Bronchial Tree, the Pulmonary Segments, The Pulmonary Vessels and Their Variations. (With summary in English, French, and German). By FRITS KAREL OTTO FRODL. Drukkerij en Uitgevers-Maatschappij v/h Kemink en Zoon N. V., Domplein 2, Utrecht, 1953.

DIE WIRBELSÄULENTUBERKULOSE UND IHRE DIFFERENTIALDIAGNOSE. Ergänzungsband 68, Fortschr. a. d. Geb. d. Röntgenstrahlen. By J. E. W. BROCHER, Priv.-Dozent, Genf. A volume of 272 pages, with 376 illustrations. Published by Georg Thieme, Stuttgart, 1953. Agents for U. S. A., Grune & Stratton, Inc., New York, N. Y. Price DM 78.–

DIE BEWEGUNGSBESTRAHLUNG. By Dr. F. WACHSMANN, Dozent für medizinische Physik, and Dr. G. BARTH, Dozent für Strahlenheilkunde und physikalische Therapie, Universität Erlangen. A volume of 192 pages, with 124 illustrations. Published by Georg Thieme, Stuttgart, 1953. Agents for U. S. A., Grune & Stratton, Inc., New York, N. Y. Price DM 36.–

DIE TELERÖNTGENTHERAPIE. By Prof. Dr. W. TESCHENDORF, Köln. A monograph of 72 pages, with 8 illustrations. Published by Georg Thieme, Stuttgart, 1953. Agents for U. S. A., Grune & Stratton, Inc., New York, N. Y. Price DM 8.70.

DIE NAHBESTRAHLUNG. By HENRI CHAOUL, Früher o.ö. Professor für Röntgenologie an der Universität Berlin, and FELIX WACHSMANN, Dozent für medizinische Physik an der Universität Erlangen. A volume of 226 pages, with 304 illustrations. Published by Georg Thieme, Stuttgart, 2d, completely revised edition, 1953. Agents for U. S. A., Grune & Stratton, Inc., New York, N. Y. Price DM 39.–

Book Reviews

THE ROENTGEN ASPECTS OF THE PAPILLA AND AMPULLA OF VATER. By MAXWELL H. POPPEL, M. D., F.A.C.R., Professor of Radiology, New York University Post-Graduate Medical School, Director of the Roentgen Ray Department, Bellevue Hospital, Consultant in Radiology, Veterans Administration Hospital, Bronx, N. Y., Consulting Radiologist United States Naval Hospital, St. Albans, Long Island, Roentgenologist, New York University Hospital, HAROLD G. JACOBSON, M. D., F.A.C.R., Director, Department of Roentgenology, Hospital for Special Surgery, Associate Clinical Professor of Radiology, New York University Post-Graduate Medical School, New York, N. Y., Attending in Radiology, U. S. Veterans Administration Hospital, Formerly, Chief, Radiology Service, U. S. Veterans Administration Hospital, Bronx, N. Y., and ROBERT W. SMITH, M. D., Senior Resident in Radiology, Veterans Administration Hospital, Bronx, N. Y. A volume of 196 pages, with 150 illustrations. Published by Charles C Thomas, Springfield, Ill., 1953. Price $8.50.

This volume records the results of a complete study of a small but important anatomic area embracing the papilla and ampulla of Vater. While it is written primarily to describe the roentgen aspects of the subject, it has strong anatomic and physiologic overtones which will appeal to all who have an interest in this subject.

The authors detail the results of their intensive study of over one hundred postmortem specimens and many surgical studies. The early chapters are written from an anatomic and developmental standpoint. One chapter is devoted to the congenital variants of the Vaterian segments. The remainder

of the text deals with the diseases and roentgen methods of study of this area. Many case reports are included. The differential diagnosis of the diseases producing a mass in this region is carefully considered.

A good bibliography of pertinent literature is included at the end of the text. An index aids in finding wanted material. The book is adequately illustrated by many radiographs. It is nicely bound and clearly printed in a single column. Radiologists, gastroenterologists and surgeons will find the work a welcome addition to their libraries.

X-RAY & RADIUM THERAPY FOR STUDENTS. By BASIL A. STOLL, F.F.R., D.M.R., (Lond.), D.M.R.T. & D. (Eng.), Late Consultant Senior Radiotherapist, Liverpool Radium Institute. With a Foreword by FRANK ELLIS, M. D., M.Sc., F.F.R. A volume of 206 pages. Published by H. K. Lewis & Co., Ltd., London, 1952. Price 17/6d. net.

The authors of this little book offer a concise presentation of the general principles of radiotherapy in conditions seen in medical and surgical practice. The text is divided into sections devoted to radiotherapy in surgery, medicine, gynecology, otorhinolaryngology, and dermatology. In its description of lesions in the various fields, attention is directed to the clinical features and pathology, and this is followed by a description of the optimal types of therapy, with special reference to irradiation. A good index and a bibliography of pertinent literature are included.

This work can be recommended as a concise reference book for the students for whom it was designed, and for those interested in the place of radiotherapy in general medical practice.

REFRESHER COURSES: POSTGRADUATE INSTRUCTION

The 1953 Refresher Course Series will be presented during the Thirty-ninth Annual Meeting of the Radiological Society of North America at the Palmer House, Chicago. The courses will open with Therapy Information at 2:30 P.M. Sunday, Dec. 13, followed by a Film-Reading Session at 7:00 P.M. Commencing on Monday, Dec. 14, there will be nine courses daily from 8:30 to 10 A.M. No other meetings will be scheduled during these hours. Attendance is limited to the medical profession, including graduate students and residents in radiology; radiation physicists, radiobiologists, chemists and others closely concerned with the science of radiology; and medical students certified by the deans of their respective medical schools.

A registration fee of $15.00, which includes the Refresher Course fee, must be paid by all nonmembers of the Radiological Society of North America at the time of registration at the Palmer House. The exceptions are guest speakers, guest instructors, scientific exhibitors, residents or fellows in radiology, medical students, trainees in physics, and officers in the Armed Forces of the United States on temporary duty and away from their practice. Members of The Radiological Society of North America do not pay a registration fee or a Refresher Course fee. All must register at the registration desk on the fourth floor of the Palmer House. Admission to the Refresher Courses will be by presentation of the registration badge and a ticket for the particular course. Payment of registration fee by non-members need not accompany the request for tickets but is to be paid when the tickets are called for at the registration desk. If you cannot use tickets you have reserved, please notify the Chairman of the Refresher Course Committee.

Read the description of the courses, noting particularly the days they are offered, and make your selection for each day. State your first, second, and third preferences. The number attending each course will be limited by the seating capacity of the room. You will be notified regarding your selections. Please pick up tickets at the registration desk, fourth floor, Palmer House.

Course No. 1: 2:30–5 P.M., Sunday

Therapy Information—Problem Cases

MILTON FRIEDMAN, M.D., New York, N. Y.
Moderator

SIMEON T. CANTRIL, M.D., Seattle, Wash.
JUAN A. del REGATO, M.D., Colorado Springs, Colo.
MAURICE LENZ, M.D., New York, N. Y.
CHARLES L. MARTIN, M.D., Dallas, Texas

Ten representative lesions treated with irradiation have been selected. Diagrams, photographs, microscopic slides, and details of treatment will have been sent to members of the panel, the result of the treatment being withheld. Each member will discuss the treatments given, indicating how and why his own technic would differ. The eventual outcome of the case will then be disclosed.

The panel members have been selected because they represent different schools of radiotherapy, and an attempt will be made to resolve differences in radiotherapeutic approach. At this session, special emphasis will be placed on treatment technics and the time factors.

Course No. 2: 7–9 P.M., Sunday

Film Interpretation Session

PHILIP J. HODES, M.D., Philadelphia, Penna.
Moderator

L. HENRY GARLAND, M.D., San Francisco, Calif.
RICHARD SCHATZKI, M.D., Belmont, Mass.
JOHN F. HOLT, M.D., Ann Arbor, Mich.

Fifteen cases have been selected for this session, which is to be a diagnostic symposium illustrating basic principles of film interpretation as well as differential diagnosis. The history of each selected case, abstract, and diagram will be distributed to all members attending this session.

Course No. 3: 8:30–10 A.M., Monday

The Anatomy of the Bronchopulmonary Segments

EDWARD A. BOYDEN, Ph.D. (Med. Sc.)
University of Minnesota Medical School
Minneapolis, Minn.

This course will review the general concept of bronchopulmonary segments, the principal variations in the segmental pattern of the bronchial tree and related pulmonary vessels, and such gross anomalies as the lobe of the azygos vein, agenesis of the lung, and the left eparterial bronchus. Also, the time and mode of origin of anomalies of the lung will be discussed on the basis of new embryologic data.

(*This course continued Tuesday, Course No. 12*)

Course No. 4: 8:30–10 A.M., Monday

Radiological Aspects of the Chest in Industry

EUGENE P. PENDERGRASS, M.D.
University of Pennsylvania, Philadelphia, Penna.

There will be a brief discussion of the etiology and pathology of silicosis. Some of the difficulties encountered in the differential diagnosis will be emphasized. A few cases illustrating the medicolegal aspects will be discussed.

Course No. 5: 8:30–10 A.M., Monday

Arthritis: Part I. Pathological Changes and Radiological Diagnosis

ELBERT K. LEWIS, M.D.
Chicago, Ill.

Numerous adjectives have been coined to qualify the type of chronic arthritis characterized mainly by inflammation in contrast to the type whose salient feature is degeneration. The terms rheumatoid and osteoarthritis are the least confusing and are chosen to denote the inflammatory and degenerative variety, respectively. Correlation will be made between the pathological changes of these two types and the radiological findings. Also, a comparison will be made of the pathological changes of tuberculous and non-tuberculous infectious arthritis and of their radiological appearances. (Lantern slides.)

Course No. 6: 8:30–10 A.M., Monday

Radiotherapy of Cancer of the Hypopharynx and Endolarynx

JUAN A. del REGATO, M.D.
Colorado Springs, Colo.

Squamous-cell carcinomas which develop in the hypopharynx and endolarynx are biologically amenable to cure by irradiation. Secondary characters, such as the location, the extent of infiltration, secondary infection, irreparability of destruction, and the presence of metastases, more often decide the radiocurability of the individual case. Although radiotherapy may control some extensive inoperable lesions, carcinomas with the most favorable outlook when treated by irradiation are the superficial, small and non-infiltrating lesions found for the most part in the endolarynx, which may also be successfully treated by surgery.

The outstanding asset of radiotherapy is its conservatism. This conservatism is enhanced and complications are minimized by the use of high-voltage good-quality radiations and protraction of the treatment over several weeks.

Details of diagnosis and technic of treatment will be discussed.

Course No. 7: 8:30–10 A.M., Monday

Roentgen Studies of the Small Bowel

PAUL C. SWENSON, M.D.
Jefferson Medical College, Philadelphia, Penna.

This course will consist of a general discussion of the roentgen findings in the small intestine as they are encountered in routine gastrointestinal work. Disorders of function as well as local and general organic change will be included: inflammatory conditions, neoplasms, diseases of the mesentery, etc.

Course No. 8: 8:30–10 A.M., Monday

X-ray Diagnosis of Benign and Malignant Bone Neoplasms

PAUL C. HODGES, M.D.
University of Chicago, Chicago, Ill.

On several occasions in the past Dr. Hodges has conducted Refresher Courses on the x-ray diagnosis of bone tumors. The Committee on Refresher Courses has convinced him that enough time has elapsed for a group of younger radiologists to have accumulated who have not attended his courses heretofore and would like an opportunity to see his material. By means of transparencies and lantern slides he will demonstrate the diagnostic criteria of the commoner benign and malignant tumors of bone.

(*This course continued Tuesday, Course No. 17*)

Course No. 9: 8:30–10 A.M., Monday

Basic Radiation Dosimetry

H. M. PARKER
Nucleonics Division, General Electric Company
Richland, Wash.

1. Influence of spatial and temporal distribution of ionizing events in tissue.
2. Energy absorption in tissue as the basis for dosimetry.
3. Direct measurement of energy absorption—calorimetry.
4. Indirect measurement of energy absorption—the Bragg-Gray principle.
5. Relationship of the roentgen to this principle.
6. Extension of dosimetry to particulate radiation.
7. Use of the term "rep."
8. Dosimetry of radioisotope distributions in tissue—the "infinite mass" simplification.
9. Simple modifications of the infinite mass case.

Course No. 10: 8:30–10 A.M., Monday

Design and Equipment of Radioisotope Laboratories

GEORGE G. MANOV
A. E. C., Isotopes Division, Oak Ridge, Tenn.

The design and equipping of radioisotope hospital laboratories are presented from the point of view of the quantity of radioisotopes involved, the types of radiation emitted, the frequency of handling, and the number of patients.

Distinction is made between laboratories that plan to use radioisotopes for diagnostic or therapeutic purposes only (such as I^{131} and P^{32}, purchased in a standardized, packaged form) and those which plan to do considerable animal and biological experimentation. Scale models of typical laboratories will be exhibited.

Course No. 11: 8:30–10 A.M., Monday

Radiation Chemistry of Aqueous Solutions

E. J. HART

Argonne National Laboratory,
Lemont, Ill.

The general nature of the chemical reactions induced by ionizing radiations in water will be treated on the basis of current ideas regarding the distribution of free radical and stable chemical species formed in irradiated water. It will be shown how studies on the effect of dosage rate, track density, concentration of solutes, pH, and presence or absence of oxygen are used to establish the identity and properties of these intermediate chemically reactive species. Application of these results to the chemical dosimetry of α, β, and γ rays and to problems in chemistry and biology will also be discussed.

Course No. 12: 8:30–10 A.M., Tuesday

The Anatomy of the Bronchopulmonary Segments

EDWARD A. BOYDEN, Ph.D. (Med. Sc.)

(Continued from Monday, Course No. 3)

Course No. 13: 8:30–10 A.M., Tuesday

Congenital Malformations of the Heart and Great Vessels

MELVIN M. FIGLEY, M.D.

University of Michigan, Ann Arbor, Mich.

The many and diverse forms of congenital malformations of the heart and great vessels can be conveniently grouped under a few principal hemodynamic alterations. These are simple left-to-right shunts, right-to-left shunts with obstruction in the lesser circulation at some points, simple obstructions in the great vessels, and malpositions of arteries with or without compressive phenomena. Since therapeutic attack is directed by these physiologic considerations, radiologic examination becomes most intelligent as a search for signs of these phenomena. After a presentation of these concepts, this course will outline the limitations and potentialities of simple roentgen methods in diagnosis of congenital cardiovascular disease. Angiocardiograms will be used only where they contribute to a better understanding of morphologic and physiologic alterations.

Course No. 14: 8:30–10 A.M., Tuesday

Arthritis: Part II. Surgical Findings and Newer Surgical Treatment of Interest to the Radiologist

H. KELIKIAN, M.D.

Chicago, Ill.

Surgical findings will be compared with radiological appearances. Preoperative and postoperative findings, as well as complications, as seen on radiographs, will be discussed. Some new methods of treatment for arthritis and indications for these as revealed radiologically will be described. (Lantern slides.)

Course No. 15: 8:30–10 A.M., Tuesday

Roentgen Anatomy of the Temporal Bone

OSCAR V. BATSON, M.D.

University of Pennsylvania, Philadelphia, Penna.

Neither descriptive anatomy nor topographic anatomy gives the roentgenologist an adequate concept of the temporal bone. For roentgen anatomy the bone can be divided into two parts, a mural or brain-case portion and a petrous portion. This latter portion projects inward from the mural portion at an angle of 45 degrees. Orienting these parts in the skull makes clear at once that there are several possibilities of obtaining a roentgen film of one portion or the other. These possibilities are reduced by the interference of overlapping shadows of other structures. The numerous suggested views of the region tend to fall into two groups: those in which the central ray is approximately at right angles to the side of the skull and those in which the central ray is at right angles to the major axis of the petrous pyramid.

The fixed space relations of the several air cavities and the criteria for identification must be understood. For example, the antrum tympanicum is always on a level with the epitympanum but posterior to it and definitely lateral to it. Similar space relations are required for the labyrinth, such as the fact that the first turn of the cochlea is always the lowest part of the labyrinth and that the superior, *i.e.*, anterior, vertical semicircular canal is at right angles to the axis of the petrous portion of the bone.

The terms used by the otologic surgeon for the typical operations are confusing in that they are common English words but are used in a specific technical sense. So long as the posterior bony canal wall is intact, the operation is a "simple mastoidectomy," while the surgical removal of a small amount of bone, if it includes the posterior canal wall, is "radical mastoidectomy."

In the infant, the bone can be readily separated into components. When this is done, a petrous antrum is displayed, as is also a squamous antrum. The cells which grow out from these may retain complete integrity, and the bone separating the two complexes forms a true Koerner's septum. Even without a definite septum it is usual to find air cells of different character in the two parts. The secondarily developed mastoid process, so prominent in the adult, is formed partly from the pars squamosa and partly from the pars petrosa. The mastoid tip cells are always from the antrum of the pars petrosa.

The roentgenologist can give the surgeon much valuable information in addition to the diagnosis. He can definitely state the size and location of the air cells and the thickness of the cortical bone, and he alone can state accurately, before operation, the location and size of the sigmoid venous sinus.

The anomalies of development are easily classified in terms of the bone of the newborn. It is doubtful if a persistent petrosquamosal suture would today be mistaken for a fracture, but the location and peculiarities of this suture must be remembered.

Structures which cast overlapping shadows are generally ignored until one of unusual size is encountered. To mention examples: the bone markings around the torcular may intrude into a Stenvers' projection; a dilated arteriosclerotic carotid artery may erode part of a petrous apex.

To illustrate and extend the above points Kodachrome slides of anatomic specimens will be used, as well as slides of roentgen films. The anatomic slides will show transparent bone preparations, sectioned and dissected bones, and a series of bones dissected to reveal the changes produced by surgery. A representative collection of anatomic specimens will be at hand to clarify points under discussion. Questions are invited.

Course No. 16: 8:30–10 A.M., Tuesday

Examination of the Colon

HENRY C. CROZIER, M.D.

Queen of Angels Hospital, Los Angeles, Calif.

Part 1: A detailed discussion of the preparation of the patient, apparatus employed, and the technic used in conventional studies and in double-contrast studies of the colon.

Part 2: Roentgenograms demonstrating the pathological entities which may be discovered in the examination of the colon.

Part 3: Discussion of the desirability of following the air-contrast examination of the colon by a conventional study on the same day.

Course No. 17: 8:30–10 A.M., Tuesday

X-ray Diagnosis of Benign and Malignant Bone Neoplasms

PAUL C. HODGES, M.D.

(*Continued from Monday, Course No. 8*)

Course No. 18: 8:30–10 A.M., Tuesday

Problems and Pitfalls in X-ray Calibrations and Protection Surveys

CARL B. BRAESTRUP

Delafield Hospital, New York, N. Y.

Discussion and demonstration of x-ray measurements of useful beam and stray radiation. Emphasis will be given to the common sources of error in calibrating x-ray equipment, including limitations of the r-meter, improper measuring procedures, and defects in equipment.

Course No. 19: 8:30–10 A.M., Tuesday

Safe Handling of Radioactive Isotopes

RALPH OVERMAN

Institute of Nuclear Studies, Oak Ridge, Tenn.

The procedures for carrying out experimental work with radioactive isotopes will be discussed, including manipulations of the quantities of radioactive materials required for therapeutic, diagnostic, and experimental work. Manipulations of the materials and evaluation of the results will be considered. Emphasis will be placed on new technics of handling and measurement.

Course No. 20: 8:30–10 A.M., Tuesday

Radiation Effects at the Cellular Level

RAYMOND E. ZIRKLE

Institute of Radiobiology and Biophysics
University of Chicago, Chicago, Ill.

This course will stress recent investigations of radiation action on genes, chromosomes, and cell division, with special reference to modification of these actions by the following factors: (1) ion density produced by the radiations; (2) chemicals in the cell or its medium; (3) portion of cell irradiated. The course will be illustrated by lantern slides and by time-lapse motion pictures showing various types of mitotic aberrations in irradiated cells.

Course No. 21: 8:30–10 A.M., Wednesday

Bone Disease in Infants and Children

HARVEY WHITE, M.D.

Children's Memorial Hospital, Chicago, Ill.

The course will attempt to make a complete survey of bone disease in infants and children. The normal variations, as well as the abnormal conditions, will be shown.

To be included in the discussions will be:

Caffey's disease
Vitamin A poisoning
Congenital anomalies of all types
Tumors
Infections before antibiotics
Infections after antibiotics
Metabolic diseases
Vitamin deficiencies
Endocrine disorders
Aseptic necrosis, etc.

Etiology and treatment will be mentioned briefly.

Course No. 22: 8:30–10 A.M., Wednesday

Roentgen Diagnosis in Urinary Tract Disease

GEORGE W. CHAMBERLIN, M.D., and
P. BOLAND HUGHES, M.D.
Reading Hospital, Reading, Penna.

This course presents the subject of urinary tract disease, from the postgraduate point of view, to radiologists familiar with the indications and contraindications, routine methods, and diagnostic criteria associated with roentgen studies.

The following topics will be discussed during the three one and one-half hour sessions allotted to the course.

1. Technical procedures, limited to recent or unusual methods or materials, including, Urokon studies, aortography, and retroperitoneal insufflation.
2. The common and uncommon congenital anomalies of the urinary tract which lend themselves to objective roentgen findings. So far as possible, some correlation will be made with responsible embryological defects.
3. The urinary tract as related to hypertension.
4. Urinary calculi: pathogenesis, clinical significance, roentgen appearance, complications, and sequelae.
5. Urinary tract infections: modern concepts of treatment in tuberculosis and non-tuberculous inflammatory disease. Roentgen diagnosis of kidney infections and their late results.
6. Trauma to the urinary tract: clinical evaluation of the time and nature of roentgen studies to be made. Radiologists' responsibility in care and handling of such patients.
7. Differential diagnosis of mass kidney lesions.
8. Renal epistaxis: various and sundry causes of renal bleeding.
9. Lower urinary tract disease: what the radiologist should know about the urinary bladder, prostate, and seminal vesicles.

(This course continued Thursday and Friday, Courses 31 and 40)

Course No. 23: 8:30–10 A.M., Wednesday

External Roentgen Therapy in Carcinoma of the Cervix Uteri

ROBERT BLOOR, M.D., R. S. QUICK, B.Sc., and
LILLIAN FULLER, M.D.
Strong Memorial Hospital, Rochester, N. Y.

The treatment of carcinoma of the cervix is primarily a problem for radiotherapy using a combined technic of internal and external irradiation. The internal use of radium can be relied upon to control the local disease in the cervix and the immediate extension in the parametria but loses effectiveness very rapidly toward the lateral pelvic wall. External irradiation is therefore used as a supplement to the internal sources to irradiate the lateral extensions of the disease more adequately.

Several plans of external irradiation have been advocated for the treatment of carcinoma of the cervix. These can be divided into two main types, those which spare the central area where the internal irradiation is most effective, and those that do not. In this course several examples of each type will be analyzed, with complete isodose plots, and the advantages and disadvantages of the various types will be compared. Suggestions will be made concerning the application of the various methods to different treatment situations and stages of the disease.

Course No. 24: 8:30–10 A.M., Wednesday

Roentgen Anatomy of the Paranasal Sinuses

OSCAR V. BATSON, M.D.
University of Pennsylvania, Philadelphia, Penna.

The roentgenologist and the rhinologist use different criteria in naming the paranasal sinuses. The roentgenologist names them on the basis of the location of the cells themselves; the rhinologist names them from the location of their ostia. With an understanding of this difference, no confusion should exist. The surgical anatomy of the sinuses is not so important as it was before recent advances in therapy. By this same token, the smaller number of cases requiring examination decreases the total experience of the examiner and makes essential a careful study of the principles of growth, variation, and relations of the paranasal sinuses.

Obtaining a satisfactory sinus film is largely a matter of displacing unwanted shadows. The chief obscurers are the two petrous bone shadows. In sinus examinations these shadows are generally thrown above or below the sinus area. Further difficulty is encountered because the sinus shadows themselves obscure each other.

The direction of extension of enlarging sinuses and the structures encountered must be considered. The roof of the orbit may be invaded by frontal, ethmoid, or sphenoid cells. The sphenoid sinus extends into the septum and into the wings of the sphenoid bone, even as far as the lateral wall of the orbit. The maxillary sinus may invade the tuberosity of the maxilla, and so on. The actual intimate relation of a sinus to a vital structure, *e.g.*, the sphenoid sinus to the optic nerve, is not considered as significant as it once was. It is, of course, extremely important to the surgeon, but we now know that the optic nerve can be involved from a distance by a retrograde thrombophlebitis. This has caused the anatomy of the veins to assume as increased importance. The veins about the paranasal sinuses are without valves, and they do not have a constant direction of flow.

SUNDAY, Dec. 13 2:30–5 P.M.	MONDAY, Dec. 14 8:30–10 A.M.	TUESDAY, Dec. 15 8:30–10 A.M.
1. **Therapy Information—Problem Cases** Milton Friedman, M.D., Moderator Simeon T. Cantril, M.D. Juan A. del Regato, M.D. Maurice Lenz, M.D. Charles L. Martin, M.D.	3. **The Anatomy of the Bronchopulmonary Segments (Continued Tuesday)** Edward A. Boyden, Ph.D. (Med. Sc.)	12. **The Anatomy of the Bronchopulmonary Segments (Continued from Monday)** Edward A. Boyden, Ph.D. (Med. Sc.)
	4. **Radiological Aspects of the Chest in Industry** Eugene P. Pendergrass, M.D.	13. **Congenital Malformations of the Heart and Great Vessels** Melvin M. Figley, M.D.
7–9 P.M.	5. **Arthritis: Part I. Pathological Changes and Radiological Diagnosis. (Part II, Tuesday)** Elbert K. Lewis, M.D.	14. **Arthritis: Part II. Surgical Findings and Newer Surgical Treatment of Interest to the Radiologist. (Part I, Monday)** H. Kelikian, M.D.
2. **Film Interpretation Session** Philip J. Hodes, M.D., Moderator L. Henry Garland, M.D. Richard Schatzki, M.D. John F. Holt, M.D.	6. **Radiotherapy of Cancer of the Hypopharynx and Endolarynx** Juan A. del Regato, M.D.	15. **Roentgen Anatomy of the Temporal Bone** Oscar V. Batson, M.D.
	7. **Roentgen Studies of the Small Bowel** Paul C. Swenson, M.D.	16. **Examination of the Colon** Henry C. Crozier, M.D.
	8. **X-ray Diagnosis of Benign and Malignant Bone Neoplasms (Continued Tuesday)** Paul C. Hodges, M.D.	17. **X-ray Diagnosis of Benign and Malignant Bone Neoplasms (Continued from Monday)** Paul C. Hodges, M.D.
	9. **Basic Radiation Dosimetry** H. M. Parker	18. **Problems and Pitfalls in X-ray Calibrations and Protection Surveys** Carl B. Braestrup
	10. **Design and Equipment of Radioisotope Laboratories** George G. Manov	19. **Safe Handling of Radioactive Isotopes** Ralph Overman
	11. **Radiation Chemistry of Aqueous Solutions** E. J. Hart	20. **Radiation Effects at the Cellular Level** Raymond E. Zirkle

PRESENTATION

WEDNESDAY, Dec. 16 8:30–10 A.M.	THURSDAY, Dec. 17 8:30–10 A.M.	FRIDAY, Dec. 18 8:30–10 A.M.
21. **Bone Disease in Infants and Children** Harvey White, M.D.	30. **Anomalies of the Urinary Tract in Children** L. L. Klostermyer, M.D.	39. **Lesions of the Chest in Infants and Children** John F. Holt, M.D.
22. **Roentgen Diagnosis in Urinary Tract Disease (Continued Thursday and Friday)** George W. Chamberlin, M.D. P. Boland Hughes, M.D.	31. **Roentgen Diagnosis in Urinary Tract Disease (Continued from Wednesday and to be continued Friday)** George W. Chamberlin, M.D. P. Boland Hughes, M.D.	40. **Roentgen Diagnosis in Urinary Tract Disease (Continued from Wednesday and Thursday)** George W. Chamberlin, M.D. P. Boland Hughes, M.D.
23. **External Roentgen Therapy in Carcinoma of the Cervix Uteri** Robert Bloor, M.D. R. S. Quick, B.Sc. Lillian Fuller, M.D.	32. **Review of the More Recent Scientific Advances in the Radiation Treatment of Cervical Cancer** Edwin C. Ernst, M.D.	41. **Cerebral Angiography** Howard L. Steinbach, M.D.
24. **Roentgen Anatomy of the Paranasal Sinuses** Oscar V. Batson, M.D.	33. **Tumors of the Eye, the Eyelids, and Orbit** Ralph M. Caulk, M.D. Alfred A. J. Den, M.D. M. Noel Stow, M.D.	42. **Carcinoma of the Male Genital System** Milton Friedman, M.D.
25. **Radiotherapy of Carcinoma of the Endometrium and Carcinoma of the Cervix** Juan A. del Regato, M.D.	34. **Lesions of the Esophagus, Stomach, and Duodenum (Continued Friday)** Cesare Gianturco, M.D.	43. **Lesions of the Esophagus, Stomach, and Duodenum (Continued from Thursday)** Cesare Gianturco, M.D.
26. **What the Chief Should Teach His Young Braves About the Economics of Radiology (To be repeated on Thursday)** W. Edward Chamberlain, M.D.	35. **What the Chief Should Teach His Young Braves About the Economics of Radiology (Wednesday course repeated)** W. Edward Chamberlain, M.D.	44. **Angiocardiography: Its Physiological Implications** Roy R. Greening, M.D. Harry Zinsser, M.D.
27. **Radium Dosimetry** Elizabeth F. Focht	36. **High Energy Accelerators for Therapy** L. S. Skaggs	45. **Dosimetry of High Energy Beams** John S. Laughlin
28. **Useful Isotope Technics** Sergei Feitelberg, M.D.	37. **Control of Diagnostic Roentgenographic Procedures** George C. Henny, M.D.	46. **Treatment Planning and Recording for Conventional X-ray Therapy** Robert Robbins, M.D. Jean Meszaros, M.S. James Bierly, M.S.
29. **Effect of Ionizing Radiations on the Embryo and Fetus** Roberts Rugh	38. **Effects of Neutrons and Roentgen Radiation on Mammals** Titus C. Evans	47. **Protective Agents Against Radiation Damage** Leon O. Jacobson

For demonstrating the above, slides of anatomic specimens will be shown along with roentgen films. Emphasis will be placed upon the peculiarities of sinus variations and upon unusual overlapping shadows. Specimens will be available for amplification and discussion.

Course No. 25: 8:30–10 A.M., Wednesday

Radiotherapy of Carcinoma of the Endometrium and Carcinoma of the Cervix

JUAN A. del REGATO, M.D.
Colorado Springs, Colo.

In the treatment of carcinoma of the cervix, the chances of cure of even advanced cases depend on the thoroughness of the irradiation and the adequacy of its planning. The technic of external pelvic irradiation will be discussed in particular detail.

A discussion of the treatment of carcinoma of the endometrium and of the important role of radiotherapy will also form part of this course, with special emphasis on the ideal combination of external roentgen therapy and hysterectomy.

Course No. 26: 8:30–10 A.M., Wednesday

What the Chief Should Teach His Young Graves About the Economics of Radiology

W. EDWARD CHAMBERLAIN, M.D.
Temple University Medical School and Hospital
Philadelphia, Penna.

Relationship of the radiologist to his patient: In private office practice; in a hospital department of radiology; factors that may affect such relationship (for example, the effect of having the radiologist's fee collected by the hospital).

Hospital-radiologist relationships: In respect to departmental administration (equation number one, "responsibility minus authority equals frustration"); in respect to the method by which the radiologist is compensated; why it is best for the radiologist to collect his own fees. Selected examples of what happens to the hospital radiologist under certain conditions. Exhibit of "impossible," bad, fair, good, and exceptionally good forms of contract, or working agreement, with examples. Exhibit of good and not-so-good bookkeeping methods.

Satisfactory hospital-radiologist relationships tend to bring top-notch radiologists into hospital practice; unsatisfactory arrangements tend to drive top-notch radiologists into private office practice, thus depriving hospital in-patients of their right to the best in medical care. Where unsatisfactory hospital-radiologist relationships exist, how much of the fault lies with the radiologist and how much with the hospital? How shall we answer the charge that "the hospital radiologist has a monopoly?"

How can the young radiologist establish himself in hospital practice on a fair and equitable basis? The advantages of being employed at the time one is negotiating with hospital management. The young man should stay in an "associateship" until he has developed the requisite stature and reputation to enable him to stand up to the hospital authorities with whom he is negotiating. The all-too-frequent error of accepting an unsatisfactory arrangement in the expectation of re-negotiation "next year." Experience proves that the radiologist's only chance to get a proper contract is when he first starts.

The impact upon radiology of Blue Cross hospitalization insurance plans, the nefarious "all-inclusive, flat-rate" method of hospital billing, etc.

(*Course repeated Thursday, Course No. 35*)

Course No. 27: 8:30–10 A.M., Wednesday

Radium Dosimetry

ELIZABETH F. FOCHT
Memorial Center, New York, N. Y.

The principles and technics of dosage calculations in the use of discrete sources for intracavitary or interstitial therapy are similar for all gamma-emitting isotopes. The fundamentals of distribution, amount, exposure, filter, and dose will be discussed for gamma-ray sources in general and then for particular variations of the more commonly employed elements, such as radium, radon, cobalt, gold, etc.

Radiographic technics for determining spatial arrangement and gadgets for working out the dose in the case of non-rigid distributions will be reviewed.

Course No. 28: 8:30–10 A.M., Wednesday

Useful Isotope Technics

SERGEI FEITELBERG, M.D.
Physicist, Mount Sinai Hospital, New York, N. Y.

1. Review of *in vivo* and *in vitro* technics suitable for clinical work; obtainable sensitivity in counting methods and resolution in profiles and autoradiography.
2. Use and performance of scintillation counters.
3. Localization of radioactive tracers in serum protein fractions by paper strip electrophoresis.

Course No. 29: 8:30–10 A.M., Wednesday

Effect of Ionizing Radiations on the Embryo and Fetus

ROBERTS RUGH
College of Physicians and Surgeons, New York, N. Y.

The embryo is more radiosensitive than is the adult of any species. Radiosensitivity is presumed to bear an inverse relationship to embryonic and fetal age. The time-schedule of embryonic differentiation can be deduced from x-irradiation studies.

Mitosis, growth, and differentiation can be distinguished by means of irradiation. These are some of the general statements which will be discussed.

The immediate effect of ionizing radiations on the various differentiating systems of the embryo will be compared with the histopathological effects manifested at birth and also with the gross effects, such as sterility and tumor genesis, which appear at or after maturity. While interpolation from studies with the rat and mouse cannot be made to the human embryo or fetus, inferences may be deduced. Such direct data as are available concerning the effects of exposure of the human embryo and fetus will be discussed.

The lecture will be illustrated with lantern slides and a colored film.

Course No. 30: 8:30–10 A.M., Thursday

Anomalies of the Urinary Tract in Children

L. L. KLOSTERMYER, M.D.
Asheville, N. C.

Statistical studies indicate that 5 per cent of all newborn infants have some type of anomaly of the urinary tract and that each year such anomalies are responsible for 12,000 deaths in the registration area of the United States. This figure can be significantly reduced by present-day urological methods of treatment, providing an early diagnosis is made.

The radiologist has a great opportunity and responsibility to assist in the diagnosis of urinary tract anomalies. In this course, most of the known anomalies will be demonstrated by urographic studies. Technics and clinical features will be stressed.

Course No. 31: 8:30–10 A.M., Thursday

Roentgen Diagnosis in Urinary Tract Disease

GEORGE W. CHAMBERLIN, M.D., AND
P. BOLAND HUGHES, M.D.

(Continued from Wednesday, Course No. 22, and to be continued Friday, Course No. 40)

Course No. 32: 8:30–10 A.M., Thursday

Review of the More Recent Scientific Advances in the Radiation Treatment of Cervical Cancer

EDWIN C. ERNST, M.D., St. Louis, Missouri

The respective clinical, technical, and statistical advantages and disadvantages of the routine radium methods most of us have relied upon in the past will be compared and evaluated with more recent radium technics. The different x-ray and radium therapy methods of the various coordinated programs will be discussed and their statistical clinical results will be evaluated. In addition, the per hour gamma roentgen measurements of the different radium intensity technics obtained with the scintillation counter crystal for each centimeter field in the pelvis will be comparatively illustrated by means of dosage charts. The total significance of streamlining and timing for the most effective x-ray and radium therapy application to meet individual clinical problems will be stressed.

Technical procedure for avoiding, or at least minimizing, early and delayed rectal and bladder injuries will be presented. These safeguards are especially helpful when the probable metastatic parametrial node extension positively requires more intensive lethal radiation saturation.

There will be question-and-answer periods, as well as a lantern slide and moving-picture demonstration.

Course No. 33: 8:30–10 A.M., Thursday

Tumors of the Eye, the Eyelids, and Orbit

RALPH M. CAULK, M.D.
Garfield Memorial Hospital, Washington, D. C.

ALFRED A. J. DEN, M.D.
Episcopal Eye, Ear and Throat Hospital, Washington, D. C.

M. NOEL STOW, M.D.
Episcopal Eye, Ear and Throat Hospital, Washington, D. C.

1. The differential diagnosis of the more common eye tumors; the indications for and results of surgical management.
2. The indications for and technics of roentgen therapy.
3. The radiographic characteristics and differential diagnosis.
4. The indications for and results of beta radiation.

Demonstration of technics and cases by lantern slides from the authors' extensive experience with the above entities.

Course No. 34: 8:30–10 A.M., Thursday

Lesions of the Esophagus, Stomach, and Duodenum

CESARE GIANTURCO, M.D.
Carle Hospital Clinic, Urbana, Ill.

This course will consist of a lantern-slide demonstration of lesions of the esophagus, stomach, and duodenum. Particular emphasis will be placed upon the correlation of various gastrointestinal studies in the course of a general radiological visceral survey. The use of compression methods and of the double-contrast technic for the examination of the gastric mucosa will be discussed in detail.

(This course continued Friday, Course No. 43)

Course No. 35: 8:30–10 A.M. Thursday

What the Chief Should Teach His Young Braves About the Economics of Radiology

W. EDWARD CHAMBERLAIN, M.D.

(Repetition of Course No. 26)

Course No. 36: 8:30–10 A.M., Thursday

High Energy Accelerators for Therapy

L. S. SKAGGS

Argonne Cancer Research Hospital,
University of Chicago

High energy accelerators (cyclotrons, betatrons, synchrotrons, linear accelerators, etc.) and nuclear reactors will be considered from the standpoint of their applicability to cancer therapy. A brief description of the machines and their operating characteristics will be given. Advantages and disadvantages will be discussed.

Course No. 37: 8:30–10 A.M., Thursday

Control of Diagnostic Roentgenographic Procedures

GEORGE C. HENNY, M.D.

Temple University Hospital, Philadelphia, Penna.

The greatest amount of information is obtained on the roentgenogram when all factors contributing to the recording of anatomic detail are used to their best advantage. An analysis will be made of these factors. It will be shown how they interact, and their relative importance will be considered. Ninety-eight per cent of things that go wrong with a roentgenogram will be found to have occurred in the darkroom. The details of darkroom procedure will be covered with particular reference to control of the constancy of development and the prevention of artifacts.

Course No. 38: 8:30–10 A.M., Thursday

Effects of Neutrons and Roentgen Radiation on Mammals

TITUS C. EVANS

University of Iowa Hospitals, Iowa City, Iowa

Neutron (fast) and roentgen radiation initiate changes in living matter through liberation of charged particles which then produce ions along their path. This ionization causes chemical changes which may result in visible injury to the cell. The ion-pairs produced by photoelectrons (from roentgen radiation) are relatively far apart except at the very end of their path. Protons (from neutron radiation), on the other hand, cause a very dense ionization along an extended range. Thus the two kinds of radiation may produce the same number of ions within a cell but the distribution in the two instances may be quite different. This is thought to account for the variation in relative effectiveness of neutrons (as compared with roentgen radiation) in leading to various kinds of damage in different cells and organisms.

In general, mammalian tissue appears to be more sensitive to neutron radiation. Organs exhibiting higher relative biological effectiveness of neutrons are the lens and the gonads. Some effects of protraction and fractionation will be discussed. Recent experiments will be reviewed, and attempts will be made to explain some of the results as due to certain mechanisms that have been proposed. These findings will also be discussed in relation to fundamental effects of ionizing radiation, radiation therapy, and radiation hazards.

Course No. 39: 8:30–10 A.M., Friday

Lesions of the Chest in Infants and Children

JOHN F. HOLT, M.D.

University Hospital, Ann Arbor, Mich.

This discussion will deal largely with non-cardiac, non-tuberculous lesions of the chest and will cover the following general topics:

A. Obstructive phenomena
B. Pulmonary suppuration
C. Neoplasms
D. Miscellaneous forms of pneumonitis

Consideration of anatomic variants, abnormalities of the ribs, and lesions of the diaphragm will be included.

Course No. 40: 8:30–10 A.M., Friday

Roentgen Diagnosis in Urinary Tract Disease

GEORGE W. CHAMBERLIN, M.D., and
P. BOLAND HUGHES, M.D.

(Continued from Wednesday and Thursday, Courses 22 and 31)

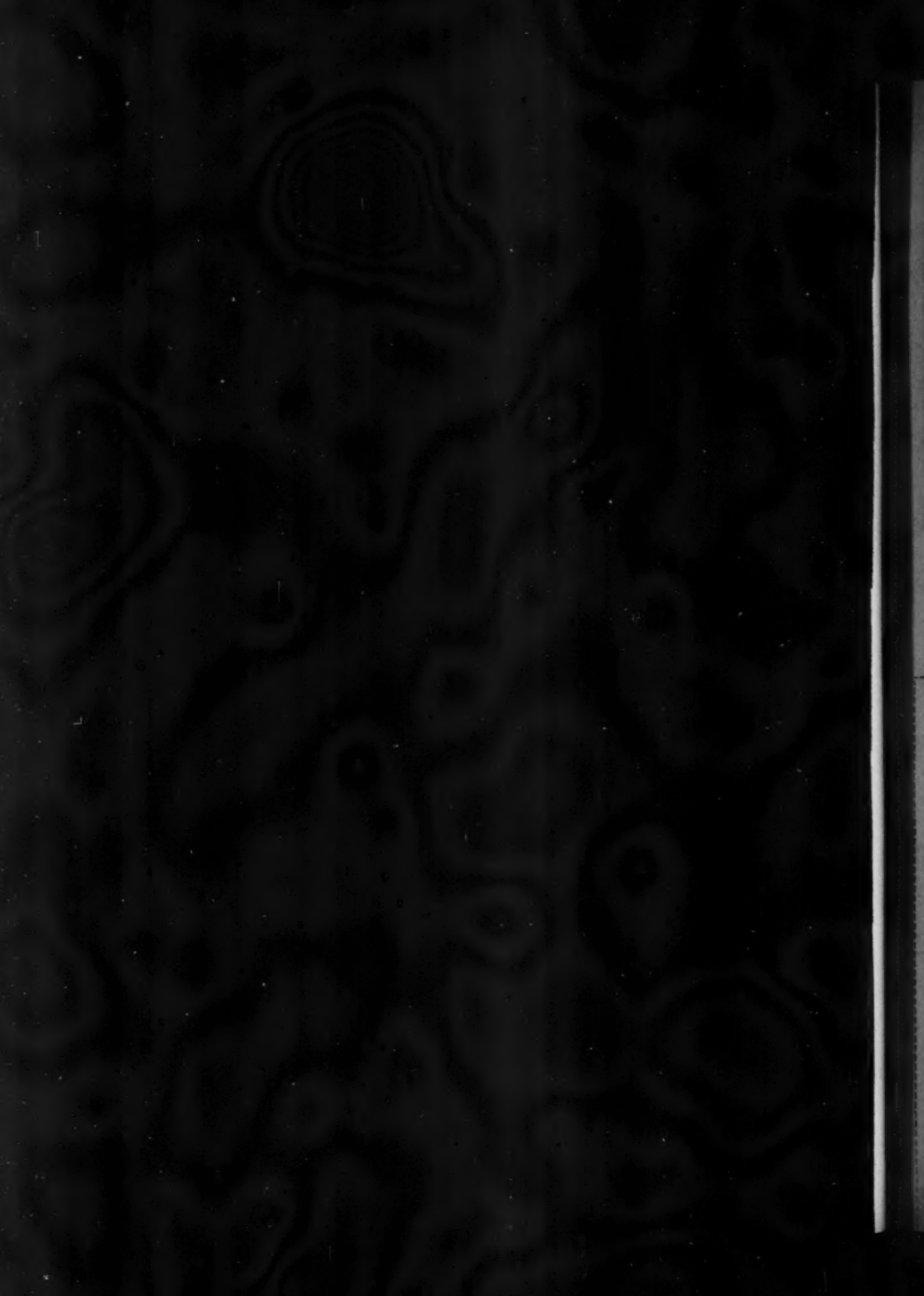
Course No. 41: 8:30–10 A.M., Friday

Cerebral Angiography

HOWARD L. STEINBACH, M.D.

University of California School of Medicine
San Francisco, Calif.

A brief discussion of the technics of cerebral angiography will be presented. The opaque media and their undesirable side-reactions will be reviewed. Roentgenograms will be presented demonstrating the normal anatomy and normal variations of the cerebral vessels, vascular occlusions, vascular malformations, and neoplasms.



REFRESHER COURSES

THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

December 13 through December 18, 1953

PALMER HOUSE

CHICAGO, ILLINOIS

(Detach here) SEE INSTRUCTIONS ON REVERSE SIDE

FILL OUT THE FOLLOWING

(Print or type) ..... M.D.
Last Name First Name or Initials

.....
Street Address

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City State

CHECK THE FOLLOWING

Member R.S.N.A. ☐ Guest ☐

Resident or fellow in Radiology at present ☐ Where.....

Medical Student ☐ Where.....

Reserve Officer on Active Duty at present ☐ Trainee in Physics ☐

Fill out, also, the enrollment diagram on the reverse side of this page

INSTRUCTIONS FOR ENROLLMENT IN

REFRESHER COURSES

Read the accompanying description of the courses and plan of presentation. Register early; the number admitted to each course will be limited by the seating capacity of the rooms. Reservations will be made in the order of the receipt of request.

Courses are limited to the medical profession, including graduate students and residents in radiology and radiation physicists, radiobiologists, chemists, and others closely concerned with the science of radiology.

All tickets will be held for you at the Registration Desk on the fourth floor of the Palmer House.

The registration fee, where applicable, will cover the cost of the Refresher Courses. Members, guest speakers, guest instructors, scientific exhibitors, residents or fellows in radiology, medical students, members of the Armed Forces, and trainees in physics do not pay a registration fee. Non-members not in these groups will pay a registration fee of $15.00, which will include the Refresher Courses.

PLEASE INDICATE YOUR FIRST, SECOND AND THIRD CHOICES

	First Choice		Second Choice		Third Choice	
	Course No.	Instructor	Course No.	Instructor	Course No.	Instructor
Sunday, Dec. 13 2:30 P.M.						
7 P.M.						
Monday, Dec. 14						
Tuesday, Dec. 15						
Wednesday, Dec. 16						
Thursday, Dec. 17						
Friday, Dec. 18						

Mail this order sheet to John W. Walker, M.D., Chairman, Refresher Course Committee
Prior to Dec. 1, 830 Argyle Bldg., Kansas City 6, Mo.
After Dec. 1, c/o Radiological Society of North America, Palmer House, Chicago, Ill.

Course No. 42: 8:30–10 A.M., Friday

Carcinoma of the Male Genital System

MILTON FRIEDMAN, M.D.

New York University Post-Graduate Medical School
New York, N. Y.

Urological lesions of radiotherapeutic interest will be discussed.

Tumors of the testis will be considered from the standpoint of histogenesis, radiosensitivity, and tumor lethal dose classification; indications for irradiation; and x-ray therapy technic.

Bladder carcinoma will be discussed from the standpoint of radiosensitivity classification, interstitial and other radium technics, and external roentgen irradiation, with special reference to supervoltage rotation therapy. The Walter Reed radium technic will be described in detail. Briefer consideration will be given to neuroblastoma of the adrenal, Wilms' tumor, and Peyronie's disease.

Course No. 43: 8:30–10 A.M., Friday

Lesions of the Esophagus, Stomach, and Duodenum

CESARE GIANTURCO, M.D.

(*Continued from Thursday, Course No. 34*)

Course No. 44: 8:30–10 A.M., Friday

Angiocardiography: Its Physiological Implications

ROY R. GREENING, M.D., and HARRY ZINSSER, M.D.

Hospital of the University of Pennsylvania,
Philadelphia, Penna.

The major portions of this presentation are to be concerned with the physiologic interpretations to be derived from angiocardiograms. Anatomical abnormalities will be described in the light of the physiological disturbances. The use of angiocardiography in the selection of patients for corrective operative procedures upon the heart is to be emphasized.

Course No. 45: 8:30–10 A.M., Friday

Dosimetry of High Energy Beams

JOHN S. LAUGHLIN

Department of Physics, Memorial Center,
New York City, N. Y.

The measurement of dose produced by x-ray and electron beams and also the measurement of the intensity of these beams involve special problems at high energies. The concepts of intensity and dose and their distinction will be discussed. The various problems which are important in measurements at different energies will be presented. The significance of the roentgen and problems associated with its use will be considered. Experimental technics for both intensity and dose measurements involving calorimetric methods, ionization chamber measurements, and scintillation crystal measurements, will be presented.

Course No. 46: 8:30–10 A.M., Friday

Treatment Planning and Recording for Conventional X-ray Therapy

ROBERT ROBBINS, M.D., JEAN MESZAROS, M.S.

Temple University Medical School and Hospital
and

JAMES BIERLY, M.S.,

Jefferson Medical College Hospital
Philadelphia, Penna.

The important features of planning a course of x-ray therapy will be discussed in terms of the factors which influence the choice of portals, their number, size, and distribution.

The methods of studying dose distribution within the body will be discussed in detail, including the methods of computing and the spheres of usefulness of (1) central axis depth dose and (2) dose distribution patterns *via* (*a*) point-plots and (*b*) summated isodose curves.

The importance of the various factors in clinical dosimetry will be reviewed, including (1) kilovoltage, milliamperage, distance, treatment area, half-value layer, etc.; (2) tumor dose, tumor-skin ratio, homogeneity; (3) time-dose relationships; (4) volume dose.

Methods of obtaining depth dose and isodose measurements will be discussed.

Participants will be given the opportunity to make summation isodose reconstructions, calculate volume doses, etc.

Finally, practical methods of computing and recording dosage will be summarized, including the limits of accuracy reasonable for clinical purposes.

Course No. 47: 8:30–10 A.M., Friday

Protective Agents Against Radiation Damage

LEON O. JACOBSON

University of Chicago Clinic, Chicago, Ill.

Data are available which conclusively show that survival of laboratory animals exposed to a single lethal dose of total-body x-irradiation can be significantly increased by measures instituted before or after the radiation injury has been sustained. Evidence is also available that the injury produced by repeated or chronic exposure to radiation can be favorably influenced. The effective prophylactic measures include the administration of such materials as estrogens, cysteine, and glutathione. "Therapeutic" measures, or, more correctly, measures in-

stituted after irradiation injury, include spleen shielding, intraperitoneal implantation of splenic tissue, intraperitoneal implantation of embryo suspensions, intravenous or intraperitoneal injection of homologous bone-marrow suspensions, and related technics. Recent evidence indicates that heterologous tissue (splenic or bone marrow) is also effective. Although the mechanisms of action of these "prophylactic" and "therapeutic" measures are not known, present evidence tends to indicate that they are different and possibly unrelated.

Discussion of the use of antibiotics, of blood and blood substitutes, which are undoubtedly important in the treatment of radiation injury, will be separated from the discussion of "prophylactic" and "therapeutic" measures referred to above, in order to emphasize the broad approach which is being taken in the investigation of the problem.

The Refresher Course Committee of the Radiological Society of North America gratefully acknowledges the work done by Dr. Edith H. Quimby in helping to formulate these courses.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

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SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, H. R. Morris, M.D., 1027 D St., San Bernardino.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, George Jacobson, M.D., 1200 North State St., Los Angeles 33. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL SOCIETY. *Secretary*, Richard C. Ripple, M.D., 1215 28th St., Sacramento. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, William H. Graham, M.D., 634 E. Santa Clara St., San Jose 12. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. W. Saunders, M.D., VA Hospital, San Francisco 21. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Wm. S. Curtis, M.D., Boulder Medical Center, Boulder. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, William A. Goodrich, M.D., 85 Jefferson St., Hartford 14. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Alvin C. Wyman, M.D., 5445 28th St., N.W., Washington. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, A. Judson Graves, M.D., 2002 Park St., Jacksonville. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, E. Hampton Bryson, M.D., 273 Alhambra Circle, Coral Gables. Meets monthly, third Wednesday, 8:00 P.M., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 490 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert M. Tankesley, M.D., 218 Doctors Bldg., Atlanta. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton Jr., M.D., University Hospital, Augusta.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, Philip S. Arthur, M.D., Suite 42, Young Hotel Bldg., Honolulu. Meets third Friday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Elbert K. Lewis, M.D., 6337 S. Harvard Ave., Chicago 21. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, John A. Robb, M.D., 23 East Ohio St., Indianapolis. Annual meeting in May.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and holds a scientific session in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Willis L. Beller, M.D., 700 Kansas Ave., Topeka. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Hugh Allan Smith, M.D., Eastern Maine General Hospital, Bangor. Meets three times a year—Spring, Summer, and Fall.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, H. Leonard Warres, M.D., 2337 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Leonard Warres, M.D., 2337 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, John R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 117 N. President St., Jackson, Miss. Meets monthly, third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, James E. McConchie, M.D., First National Bank Bldg., Independence, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Francis O. Trotter, Jr., M.D., 634 North Grand Blvd., St. Louis 3. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Salomon Silvera, M.D., 921 Bergen Ave., Jersey City. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 8:45 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Frank Huber, M.D., 131 Fulton Ave, Hempstead, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Harold W. Jacox, M.D., 622 W. 168th St., New York 32.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Gordon Ide, M.D., 277 Alexander St. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary*, Clifford C. Baker, M.D., Harwood Bldg., Scarsdale. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Milton Berg, M.D., Quain & Ramstad Clinic, Bismarck. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. M. Thompson, Jr., M.D., 316 Michigan St., Toledo. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Chapin Hawley, M.D., 927 Carew Tower, Cincinnati 2. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Herbert M. Stauffer, M.D., Temple University Hospital, Philadelphia 40. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Donald H. Rice, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., 1037 Stuart Bldg., Lincoln, Nebr.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. William A. Klauber, M.D., Self Memorial Hospital, Greenwood. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, Harvey Thompson, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., Newell Hospital, Chattanooga 2. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, Claude Williams, M.D., Fort Worth. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Harry Fishbein, M.D., 324 Medical Arts Bldg., Houston 2.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Building, San Antonio 5, Texas. Meets at Brook Army Medical Center, the first Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 29–30, 1954, Dallas.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John N. Burkey, M.D., 555 Medical-Dental Bldg., Seattle. Meets fourth Monday, September through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Jerome L. Marks, M.D., 161 W. Wisconsin Ave., Milwaukee 1. Meets monthly on fourth Monday at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. W. Moir, M.D., Sheboygan Memorial Hospital, Sheboygan.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Rafael A. Blanes, M.D., Box 9724 Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, D. L. McRae, M.D. Assoc. Hon. Secretary-Treasurer, Guillaume Gill, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday of each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. Secretary, Dr. Rafael Gómez Zaldívar. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPÍA. *General Secretary*, Dr. Dionisio Pérez Cosio, Marsella 11, Mexico, D.F. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Second-Day Pneumoencephalography. John A. Stewart. Am. J. Roentgenol. **68:** 749–753, November 1952.

A series of 51 cases in which pneumoencephalograms were obtained on apparently normal brains is presented. Twenty-two additional cases with a history of trauma or organic disease were also studied. The combined series is reviewed from the standpoint of change in size of the ventricular system as demonstrated roentgenographically on the day following pneumoencephalography.

Although slight changes were seen to be present, they were not considered statistically or diagnostically significant. In spite of this, it is urged that second-day pneumoencephalography not be discarded, since it has been shown to accentuate lesions of the brain that were questionable on the original examination.

Six tables.

G. E. Ross, M.D.
Indiana University

Air Embolism Eight Hours After Ventriculography. A Case Report. F. Heppner. Acta radiol. **38:** 294–298, October 1952.

The details of a case of glioblastoma multiforme with development of a cyst projecting into the lateral ventricle are presented. Ventriculography was carried out in the usual manner, and eight hours later the patient suddenly expired. Autopsy demonstrated air embolism with filling of the right heart and a laceration of a subependymal vein in the right lateral ventricle. The author postulates an explanation for the delayed air embolism based upon a negative venous pressure due to the position of the patient with the upper part of the body raised. In view of this sequela it is concluded that the more conservative ascending type of pneumoencephalography should be utilized.

Three roentgenograms.

James E. Lofstrom, M.D.
Detroit, Mich.

Sturge-Weber-Dimitri Disease. Follow Up of a Case. R. H. Sakr and M. K. Gabr. Arch. Pediat. **69:** 425–431, November 1952.

The authors report a case of Sturge-Weber-Dimitri disease (venous angioma of the face, meninges, and brain, associated with contralateral jacksonian convulsions and intracranial calcification) in an Egyptian boy first seen at the age of five years. Of interest to the radiologist is the demonstration of areas of calcification, particularly marked in the left occipital region. During the year and a half over which the patient was observed there was a definite increase in the extent and density of the calcific shadows paralleling the clinical deterioration.

Two roentgenograms; 1 photograph.

Chronic Subdural Hematoma in an Adult Producing Marked Erosion and Perforation of the Overlying Dura and Skull. J. M. Meredith and George R. Gish, Jr. J. Neurosurg. **9:** 639–643, November 1952.

A 32-year-old Negro male complained of weakness in the legs for two weeks, occipital headache, and pain in each eye. He gave no history of trauma. The day prior to admission he became quite drowsy. On neurologic examination, the right pupil was found to be larger than the left and to react sluggishly to light. There was questionable slight primary atrophy of the optic disks bilaterally.

Roentgenograms of the skull showed a 4 × 6-cm. area of bone destruction in the left parietal region and complete erosion of both the inner and outer tables over a smaller area. There was no visible zone of reaction about the area of destruction. The appearance suggested erosion due to underlying pressure. The findings on left carotid arteriography were normal.

Bilateral frontal burr openings made with a view to ventriculography (subsequently abandoned) revealed bilateral chronic subdural hematomas of moderate size. Subsequent hydration of the patient improved his condition markedly. Fourteen days later a bone flap was turned down over the area of the bony defect in the left parietal area, and a third chronic subdural hematoma was uncovered. This had perforated the dura and had almost completely eroded three small areas in the parietal bone. The hematoma was easily removed and the defect in the skull was closed with a tantalum plate. The patient made an uneventful recovery.

Microscopic examination of the bone specimen was unfortunately omitted, but it is held to be unlikely that any pathological process other than the erosion and perforation of the skull would have been discovered, since the preoperative angiogram showed no unusual vascular pattern, and also because of the findings at operation and the continued well-being of the patient more than a year later.

Two roentgenograms.

Richard F. McClure, M.D.
Palos Verdes Estates, Calif.

Symptomatic Laryngocele in Cancer of the Larynx. Piero Meda. Arch. Otolarying. **56:** 512–520, November 1952.

Laryngocele is a dilatation of the appendix of the laryngeal ventricle. It arises from the anterior portion of the ventricle and may bulge into the larynx as a smooth, round mass, or may extend outward into the cervical region through points of minor resistance, especially through the thyrohyoid membrane. It has been shown that in the presence of laryngeal disease inflation of the ventricular appendix may be observed, under x-ray examination, more frequently than in healthy persons. Normally the appendix may be demonstrated only by increasing the intralaryngeal pressure. Evidence of an inflated ventricular appendix suggests the presence of edema or of a deep infiltration at the level of the neck of the appendix. This is explained as due to the presence of a valve-like mechanism produced by stenosis of the neck, which allows the entrance but not the exit of air.

On roentgenograms the laryngocele appears as a transparent image projected over the laryngeal and paralaryngeal structures. In the lateral projection the laryngocele generally crosses the outline of the inferior half of the laryngeal face of the epiglottis. On the frontal stratigram, the appendix appears in the anterior section as a fissure prolonging the ventricular outline upward and extending in the aryepiglottic wall corresponding to the lateral edges of the vestibule. When the laryngocele is markedly developed, it may be projected over the higher portions of the larynx in

proximity to the free edge of the aryepiglottic fold or close to the body of the hyoid bone. When it has expanded beyond the thyrohyoid membrane, it appears projected over the soft parts of the neck.

The author believes that the presence of a laryngocele is in itself a definite sign pointing toward the diagnosis of primary or secondary cancer of the ventricle. This diagnosis becomes more certain when the endoscopic and roentgenologic findings support a ventricular localization of the tumor.

At the Otorhinolaryngological Clinic of the University of Milan, from which this report comes, laryngocele was found in 6 of 650 cases of laryngeal cancer; in 4 of the cases the demonstration was exclusively roentgenologic.

Seven roentgenograms; 5 drawings; 4 photographs.

HOWARD L. STEINBACH, M.D.
University of California

THE CHEST

Roentgen Aspects of Carcinoma of the Lung. Lester W. Paul. Wisconsin M. J. **51:** 1087–1090, November 1952.

In order to evaluate the significance and frequency of occurrence of the various roentgen signs of carcinoma of the bronchus, the author reviewed 148 proved cases. The findings are divided into seven roentgenologic categories, including one group of 15 cases designated as "miscellaneous." The other six types are as follows:

(1) *Mediastinal involvement:* In 2 cases there was spread to the mediastinum with roentgen signs of a mediastinal mass. Both lesions lay near the tracheal bifurcation, producing a wide lobulated shadow which was mistaken for lymphoblastoma.

(2) A *unilateral hilar mass* was present in 10 instances. In such cases fluoroscopy may show evidence of obstructive emphysema, with the lung remaining distended at the end of expiration, or may reveal merely a decrease in air exchange as compared to the opposite side. Bronchography clearly demonstrates the deformity or obstruction.

(3) The finding of a *hilar mass plus evidence of atelectasis* of a lobe or segment is a very characteristic pattern of carcinoma of the lung. This combination was seen by the author in 33 cases of his series and was second in frequency only to (4) *atelectasis alone*, which was present in 55 cases. A few of the latter group were complicated by pleural effusion or infection.

(5) *Central nodular mass:* In 8 cases, the tumor manifested itself by a nodular, circumscribed, clearly outlined mass close to but separated from the hilus, often measuring 6 to 8 cm. in diameter. The mass was seldom spherical but tended rather to a slightly lobulated outline. No atelectasis was found. Bronchography is of some value in the study of this type of lesion. The occluded bronchus is usually found to be a segmental one, and the sharp cut-off of the oil shadow is quite distinctive.

(6) *Peripheral mass:* With the wide use of photofluorography of apparently healthy individuals, the finding of a small mass or shadow on or close to the pleural surface is becoming increasingly frequent. The particular ones which are situated in the apex of the lung were described by Pancoast as invading a rib and producing characteristic neurological findings. Of the 25 cases in this group, 8 were discovered on routine chest films. Differential diagnosis of peripheral tumors is often a difficult problem. Confusion with inflammatory lesions is common and the author feels that Bucky roentgenograms and planigrams are of distinct value, since by this means even small amounts of calcium may be identified, a finding which "is almost certain evidence that the lesion is not a carcinoma."

Six roentgenograms.

LAWRENCE R. JAMES, M.D.
Boston, Mass.

Malignant Neoplastic Disease Discovered in Chest X-Ray Surveys. Gabriele Bondi and Vera Leites. New England J. Med. **247:** 506–512, Oct. 2, 1952.

This report on the demonstration of malignant neoplasms on routine chest films is based upon surveys conducted by the New York City Department of Health during the calendar years 1949 and 1950, organized on an occupational and a regional basis. A wide variety of occupational groups were included.

The authors summarize their observations as follows:

"Among 228,375 persons surveyed, 184 (0.8 per 1,000) were considered to have findings suspicious of malignant neoplastic disease.

"Twenty-seven cases (roughly 1 per 10,000) of previously unknown primary malignant tumor were found; in 24 of these, the diagnosis was proved by histologic examination.

"In the proved cases, 3 patients had Hodgkin's disease, 20 bronchogenic carcinoma and 1 a hemangioendothelial sarcoma.

"In the 3 cases of Hodgkin's disease, the diagnosis was established by biopsy of a superficial lymph node; in the 21 pulmonary tumors, the diagnosis was established by surgical exploration in 15 cases, by bronchoscopy in 2 and by demonstration of malignant cells in the pleural fluid in 4.

"Sixteen of the patients with pulmonary tumors were subjected to surgical exploration, and 12 were found to have resectable lesions.

"Twenty cases of pulmonary metastasis of extrathoracic tumors were found.

"In 60 cases, the suspicious x-ray findings were due to non-malignant conditions; in 16, full-size x-ray film did not reveal any abnormality.

"In 58 cases, work-up could not be completed, and the diagnosis remained undetermined."

The authors, neither of them radiologists, feel that there is a lack of specific and reliable roentgenological criteria for pulmonary cancer.

The following abnormalities on the survey film were considered to carry a probability of neoplasm: (*a*) a single, circumscribed, round or ovoid shadow; (*b*) multiple round circumscribed shadows; (*c*) dense, more or less homogeneous parenchymal shadows of irregular shape; (*d*) changes suggestive of atelectasis; (*e*) widening of the mediastinal shadow or densities adjacent to the mediastinal structures; (*f*) status postmastectomy, with pleural effusion or parenchymal shadows, or both; (*g*) rib abnormality suggestive of neoplasm. Discrete lesions found to have calcium within them were considered as probably benign.

Unless full-size x-ray films, tomographs, available previous films, positive sputum tests, or other specific findings quickly disproved the suspicion raised by the survey film, the case was considered as an emergency and the patient was referred to a hospital with exploration in mind. This policy subjects a number of patients with non-malignant conditions to the risk of operation. The decision as to whether or not to advise operation

in the case of a silent lesion may be very difficult and involves a heavy responsibility. With the diagnostic tools at our disposal at present, a certain subjective and sometimes arbitrary element enters unavoidably into the evaluation of the potential malignancy of a lesion. However, with the present low operative mortality, it appears that less harm will be done in removing a non-malignant lesion than in missing the resectable phase of a malignant one.

Two tables. MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Cysts of the Lung. Thomas Lodge. Proc. Roy. Soc. Med. **45:** 629–634, September 1952.

The author first presents the classification of cysts of the lung offered by Rizzi and de Lorenzi in a recent monograph. This consists of two divisions, parasitic and congenital. Hydatid cysts are the most common representatives of the parasitic group. They are most commonly posterior in location. At first round and of even density, they grow rather slowly and may later lose their round shape.

Of the congenital cysts, dermoids are most common. They are apparent as dense paramediastinal shadows, round or oval, increasing steadily in size. They are primarily mediastinal but may encroach upon the medial lung borders. They may contain teeth and sometimes calcify. They are rarely lobulated. Other congenital cysts are rare and without distinguishing features except that thyroid cysts are usually mediastinal in location and tend to calcify and lymphatic cysts are often multiple, in chain formation.

Alimentary cysts of either gastric or esophageal origin characteristically lie posteriorly in a paravertebral situation.

Cysts of pericardial origin may lie close to the pericardium or at some distance from it in the lung. They frequently do not reflect cardiac pulsation. In the juxta-pericardial variety, the author has noticed a narrow translucent layer between the cyst and the pericardium proper which he thinks is due to a layer of fat and which may be characteristic. The pericardial cyst has a predilection for the right side and may have to be differentiated from pericardial hernia, tumor, or encysted effusion.

Pleural cysts may be either air- or fluid-containing. The air cysts are often multiple and look the same radiologically as subpleural emphysema, consisting of a group of annular shadows forming a "soap-bubble" appearance.

Seromucinous or bronchogenic cysts have been held to constitute 23 per cent of all lung cysts. To this group numerous theories of origin have been applied. The author outlines the inflammatory theory, though he does not claim that this represents "either the whole or the permanent truth." He points out that anything which interferes with the natural freedom of the bronchus to dilate and contract may produce the effect of a check-valve. In these circumstances a zone of lung, which may be a lobule, a segment, or a lobe, depending on the size of the bronchus involved, becomes progressively distended. An example of this phenomenon is furnished by the acute air cysts frequently encountered in the pneumonias of childhood, so-called pneumatoceles. These appear radiologically as circular air-filled cavities with a sharp thin border, sometimes with a fluid level.

In discussing the radiologic features, the author divides cysts of the lung into those containing fluid and those containing air. Fluid cysts are usually round or oval and of uniform density. They may simulate carcinoma and should be explored. Nevertheless, it is unusual for carcinoma to be completely round in the absence of hemorrhage. A hamartoma cannot be distinguished from a fluid cyst. Other confusing lesions are metastases, tuberculoma, and arteriovenous fistula. Tuberculomas contain calcium more often than cysts. Angiography or tomography may demonstrate large vessels associated with the vascular lesions.

Air cysts are characteristically hair-line annular shadows, nearly always round and usually situated in the center of the lung. They should be distinguished from abscesses, pleural rings and bullae, as well as from rare conditions such as parasternal hernia.

Emphysematous bullae are similar in many respects to cysts. They are to be regarded as distention sacs and may become quite large, but they have no complete cellular lining and rarely contain fluid. The boundary between air cysts and bullae is uncertain, but if the lesion is larger than a tangerine it is more likely to be a bulla. In the latter case there will probably be other evidence of emphysema. Bullae almost invariably fail to fill with Lipiodol, while cysts may fill.

Seven roentgenograms; 1 photograph.
MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Intrathoracic Cysts Occurring in a Patient Who Had Received Oleothorax. Wilson Weisel and John D. Conway. Am. Rev. Tuberc. **66:** 601–604, November 1952.

In a patient seen fifteen years after conversion of a pneumothorax to an oleothorax with mineral oil, roentgenograms showed dense-walled cysts in the right lower lung fields. The patient was explored and three cystic masses were encountered in the anterior basal portion of the right hemithorax. Since it was felt that they interfered with collapse of an apical cavity by means of thoracoplasty, two of them were removed. Microscopic examination showed that the walls were made up of hyaline and partially calcified tissue. The semi-viscid gray fluid appeared to contain no oil, but the cyst formation was felt to be related to the oleothorax. The authors could find no reports of similar cases in which oleothorax led to the formation of cystic lesions interfering with surgical collapse procedures.

Three roentgenograms. JOHN H. JUHL, M.D.
Minneapolis, Minn.

Localized Pulmonary Hypertrophic Emphysema. Mark H. Williams. J. Thoracic Surg. **24:** 522–529, November 1952.

Localized pulmonary hypertrophic emphysema is an extraordinarily rare type of cystic disease of the lung. Ten examples of the disease have been described previously in the literature, in five papers. The two adult patients in this group, however, are not considered by the present writer to be acceptable, since in one of these the disease was an incidental autopsy finding and in the second there was associated sarcoidosis of the lung and hilar nodes. All of the 8 remaining cases occurred in infancy or early childhood.

The author adds a case in a seven-month-old male

infant, who was dyspneic from birth and was admitted to the hospital because of cough, dyspnea, and cyanosis. A diagnosis of bronchial asthma had been made, and there was a superimposed acute tracheal bronchitis. Roentgen studies of the chest showed hyperaeration on the right with partial atelectasis of the right lower lobe. The heart and mediastinum were displaced to the left. The lateral view showed increased anteroposterior diameter of the chest. The patient recovered from the acute tracheal bronchitis and was readmitted to the hospital a few weeks later, when roentgenograms still showed hyperaeration on the right and mediastinal shift to the left. Wheezing and dyspnea were still present. Later, thoracotomy was done following a diagnosis of cystic disease of the lung.

The right middle lobe was found to be enormously enlarged and emphysematous, while the right upper and lower lobes were almost completely atelectatic. The middle lobe was removed and, in spite of two episodes of cardiac arrest during surgery, the patient recovered. The resected lobe of the lung was pale and studded with numerous small blebs. There was no gross abnormality of the larger bronchi. The peripheral portion of the lung consisted of large ballooned-out spaces produced by intercommunicating alveolar sacs. In places the alveolar ducts up to and including the respiratory bronchioles formed part of the wall of these spaces. Some of the septa revealed marked bullous thickening; others were extremely delicate and lined with flattened cells. The picture suggested a type of congenital cystic disease of the lung in which the terminal and respiratory bronchioles do not constitute the major feature. The patient recovered well and up to two and a half years appeared normal in every respect. Follow-up chest films were normal.

The author includes a table summarizing the cases reported in the literature and gives a short discussion of the treatment, pathology, and etiology of the condition. In some instances a valve mechanism produced by a fold of mucous membrane in the stem bronchus was found to be the cause. In others no specific cause could be discovered.

Five roentgenograms; 1 photomicrograph; 1 table.

C. J. CORRIGAN, M.D.
St. Paul, Minn.

Some Problems in Roentgen Diagnosis of Silicosis. Eugene P. Pendergrass. J.A.M.A. **150:** 1178–1179, Nov. 22, 1952.

It is generally conceded that the roentgen examination, properly done, is the most precise method available for demonstrating visible shadows of pathological changes produced by silicosis. There is a general impression that most pulmonary lesions 2 to 3 mm. in diameter are demonstrable on conventional films, but small subpleural nodules may not be distinctly enough shown that they can be recognized and interpreted. The failure to record larger lesions is not generally appreciated. The author directs attention to three groups of cases.

Group I consists of cases in which a comparison of antemortem and postmortem films was made. It is illustrated by three case reports:

1. In a man who died with a blood picture resembling acute leukemia, postmortem films showed a 1-cm. lesion which had apparently not been recognized prior to death, the shadow being superimposed upon a rib.

2. In a young Negro woman having a breast mass and jaundice, antemortem chest films were not remarkable, but films of the excised lungs twenty days later showed numerous bilateral lesions 2 to 3 cm. in diameter. The author believes these lesions were present prior to death, but were not demonstrable.

3. A man of 43 died three days after a head operation. An antemortem chest film showed a large lesion in the region of the left hilus. Films of the excised lungs revealed a metastatic lesion 5 to 7 cm. in diameter not seen on the films made three days before.

Group II concerns the roentgen diagnosis of bronchogenic carcinoma in persons who have silicosis. Isolated conglomerate or small massive silicotic pulmonary lesions without nodulation present a difficult problem. The author mentions two cases in which an incorrect diagnosis of carcinoma was made. The isolated silicotic lesion was demonstrated at subsequent operation, and, in addition, many silicotic nodules could be seen in the microscopic slides. These had not been seen in the roentgenograms.

Group III consists of cases of silicosis with a long follow-up. The author has observed that, over a period of ten or more years, massive peripheral upper lobe silicotic lesions may migrate toward the hilus, where they may simulate mediastinal tumors.

MARSHALL B. TUCKER, M.D.
Oakland, Calif.

Clinical Aspects of Occupational Diseases. Diagnosis of the Occupational Dust Diseases of the Lungs. A. I. G. McLaughlin. Proc. Roy. Soc. Med. **45:** 603–609, September 1952.

The diagnosis of a particular kind of industrial pulmonary disease cannot be made from the roentgenograms alone. The presence of nodular or miliary shadows distributed evenly over both lungs must be considered as non-specific. The roentgen appearance of all dusty lungs has a basic pattern, the dust aggregates being found mainly in the peribronchial and periarterial lymph channels and nodes.

Those dusts which produce fibrosis of the lungs cause symptoms. Others, such as iron oxide, produce an alarming roentgen picture, but the patients are asymptomatic because there is no fibrosis. It is also well known that many non-industrial lesions, such as sarcoidosis, miliary tuberculosis, carcinomatosis, etc., have a similar roentgen picture. In view of this, it is necessary to have a full occupational history with details of exposure to various dusts, and to supplement this with a clinical examination.

The author presents an uncomplicated case of silicosis and cases of other industrial and non-industrial conditions which might lead to confusion if diagnosed solely on the basis of the roentgenogram.

Eight roentgenograms; 4 photomicrographs.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

A Study of the Positive Roentgenographic Findings for the 1948 Washington Mass Survey. Two-Year Status. Howard M. Payne, Philip Enterline, and Julia Heuck. Am. Rev. Tuberc. **66:** 548–566, November 1952.

One of the most important findings in the examination of the 440,339 persons in a survey undertaken in Washington, D. C., was the incidence of tuberculosis in

older age groups. The case rate per 1,000 persons examined was 5.1 in the group from fifteen to fifty-four years and 30.3 in persons fifty-five years of age and older. Furthermore, in the latter group, only 39 per cent were known cases, while in the group from fifteen to fifty-four years, 79 per cent of the cases were known prior to the survey. The findings indicate the importance of examining the older group in any case-finding mass survey.

The two-year follow-up was not completely planned in advance, so that difference in terminology and methods of recording observations made the study unnecessarily difficult. A tabulation for the follow-up of cases discovered in surveys is presented, which is aimed at developing a uniform standard of comparison upon which to base analyses of findings. The need for improvement of clinic and laboratory facilities, and for more public-health nursing follow-up, was also demonstrated by the study.

The survey further indicated that concerted efforts are required to control tuberculosis effectively, since many of the patients with disease were "lost" and an estimated 3,689 unknown cases of tuberculosis in Washington were not found because the total population of the city was not examined. Extensive statistical studies are presented in tables and graphs.

Five graphs; 12 tables. JOHN H. JUHL, M.D.
Minneapolis, Minn.

Two Cases of an Unusual Form of Pneumonia. N. S. F. Proctor, B. Agranat, A. Brink, and J. H. S. Gear. South African M. J. **26:** 955–959, Nov. 29, 1952.

The authors present two cases of pneumonia, both having a fatal outcome and unusual pathologic findings. The patients were white females aged 29 and 31 years. Clinically, there was an initial upper respiratory infection resembling influenza, with apparently complete recovery. In three to four months, symptoms of cough, hemoptysis, and dyspnea appeared, increasing steadily in severity, with cyanosis, and terminal asphyxia. One patient had a history of rheumatic fever in childhood with full recovery. Both patients gave a positive Coombs test.

Roentgenologically, changes in the lung fields followed the onset of symptoms by one month in one case and were present on admission in the other. The roentgenograms revealed a diffuse, ill-defined mottling of a coalescent type, more marked in the bases and fading in the mid-lung fields. The second case exhibited a slight "sunburst" effect from the hilar areas. The pulmonary changes progressed with the increasing severity of the clinical symptoms.

The first patient died nine months after the initial upper respiratory infection, and the second three months after the initial episode. At autopsy, the lungs showed intense congestion and there were heavy eosinophilic hyaline membranes in the alveoli. There were many mononuclear cells present, with a paucity of polymorphonuclear leukocytes. Similar histologic findings have been reported in virus pneumonias, rickettsial pneumonia, and rheumatic pneumonia. No specific organism was identified in either case. [Meschan and his associates have described a case in an infant showing the presence of a hyaline membrane over the terminal bronchioles and alveolar ducts. See Radiology **60:** 383, 1953.—M. H. J.]

The authors postulate that in view of the positive Coombs test and the pathologic findings, these cases may have been on an auto-allergic basis.

Three roentgenograms; 4 photomicrographs.
M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

New Roentgenographic Technique in Bronchial Asthma. C. Jiménez Díaz, C. Albert, V. L. Barrantes, F. Lahoz, L. Salgado, and C. Lahoz. J.A.M.A. **150:** 1297–1298, Nov. 29, 1952.

To obtain information regarding pulmonary function in asthmatic persons, the authors superimpose two chest films, one made during deep inspiration and the other during expiration, the spine being used for orientation. By noting relative shift of the diaphragm, ribs, and clavicles, various forms of respiration are detected.

In normal individuals diaphragmatic motion prevails over rib and clavicular motion. In asthma without complications three types of respiration are noted. In the most common type the diaphragmatic motion is absent or diminished and there is increased rib and clavicular motion. In another type rib expansion is limited and diaphragmatic motion is piston- or pump-like. Clavicular motion is also increased in this type. In the third type rib and diaphragmatic motion are restricted and clavicular motion is excessive. This method offers an index to the degree of bronchial obstruction present, whether it be productive of emphysema or atelectasis. The expiratory film is also of merit in determining the presence of generalized bronchial obstruction, pulmonary edema, congestion, and interstitial fibrosis.

Four roentgenograms. ROBERT RAPP, M.D.
University of Michigan Hospital

Collapse of the Lung and Bronchography. Eelco Huizinga and C. G. Sypkens Smit. Acta radiol. **38:** 389–398, November 1952.

This paper is devoted to the study of the bronchopulmonary segments of those portions of lung compressed by an elevated diaphragm or by an intrathoracic mass. The authors note the frequency of elevation of the diaphragm appearing secondary to sub- or supradiaphragmatic inflammatory processes. It is important to recognize that this does not necessarily mean absorption atelectasis.

Only the basal part of the lung is compressed, giving rise to a characteristic bronchographic picture. Alveolar filling is absent ("naked filling") and the larger bronchi are compressed. After recovery and reventilation of the lower lobe, normal bronchi reappear. The appearance of the "naked filling" and compression may be mistaken for bronchiectasis.

Six cases are reported, with accompanying bronchograms which nicely exemplify the "naked filling" and bronchial compression. The authors emphasize that the effect of compression on the lung is limited rather than affecting the whole lung evenly. One case is shown in which, following therapeutic pneumoperitoneum, the diaphragm, especially on the right, was elevated. No bronchial compression was evident in the basal segments or elsewhere. "This can hardly be explained in any other way than by assuming that there are individual differences depending on the amount of elastic tissue present in the lung."

Seven roentgenograms. BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Thoracic Aortography After Direct Puncture of the Aorta from the Jugulum. Ingmar Wickbom. Acta radiol. **38**: 343–349, November 1952.

The author describes a technic for thoracic aortography. The examination is performed with the patient in the supine position. A puncture with a long needle is made above the right clavicle, just lateral to the common carotid artery. From this point, by means of the prescribed technic, the ascending aorta is punctured obliquely. Contrast medium is injected and 10 pairs of films are taken in ten seconds, at right angles to one another.

This method had been used in 8 cases. No difficulty was encountered in making the puncture. In 2 patients a mediastinal hematoma developed. In one case this disappeared in two days and in the other in a week. One patient had a serious reaction to the contrast injection and died the following day from circulatory insufficiency (see following abstract). With the method described there is excellent contrast filling of the aorta and its branches. The procedure is simple and less time-consuming than aortic catheterization and requires no vessel ligature.

Six roentgenograms. BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Death Following Contrast Injection into the Thoracic Aorta. Case Report. Ingmar Wickbom. Acta radiol. **38**: 350–354, November 1952.

The author reports a death following injection of contrast medium directly into the aorta according to the technic described in the paper abstracted above.

The patient was a 66-year-old woman who was being studied because of a large pulsating mass palpable over the manubrium. Innominate artery angiography was performed, revealing this to be a highly vascular tumor, fed mainly by the internal mammary artery. To study the relationship of the tumor to the aorta, aortography was carried out under general anesthesia. The patient had no reaction to the puncture. Thirty c.c. of Dijodon, 70 per cent (a medium of the Diodrast type), was injected in about three seconds. Following this the pulse became rapid and feeble and the blood pressure fell from 240 mm. Hg to 80 mm. There was partial recovery following stimulation but recovery was never complete, and the patient died the following day. Autopsy showed no changes ascribable to the puncture. The tumor was found to be a malignant goiter.

The films showed contrast filling of the coronary arteries for at least seven seconds. Also all the films appeared to have been taken in diastole, suggesting that there was no heart action for at least seven seconds. Thus it seems likely that damage of the myocardium resulted partly from ischemia and partly from the contrast substance in the coronary arteries.

Negative autopsy findings, so far as any damage due to the puncture is concerned, are held to support the opinion that the author's method of direct puncture of the aorta is a practicable one. It is felt, however, that media of the Diodrast type, if remaining long in the coronary vessels, may cause ischemia of the myocardium; and for that reason thoracic aortography should be avoided if a slow circulation time is suspected.

[No note is made of the time interval between the innominate and aortic angiography or of the contrast medium used for the former.—B.L.]

Four roentgenograms. BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Roentgenographic Localization of Descending Aorta. Use in Infant with Tetralogy of Fallot. Harry F. Zinsser, Jr., Truman G. Schnabel, Jr., and Julian Johnson. J.A.M.A. **150**: 1200–1202, Nov. 22, 1952.

In congenital cardiac anomalies characterized by cyanosis due to inadequate blood supply to the lungs, it is customary to delay surgical shunting procedures until the child is four to eight years old. Occasionally, in severely handicapped children it is necessary to operate at an earlier age.

The authors believe the Potts-Smith-Gibson type of operation to be most suitable for infants, but a prior knowledge of the location of the descending aorta is imperative. They report one case of tetralogy of Fallot, in an infant of four and a half months, in whom angiography could not be done because of the critical condition of the patient. Identification of the descending aorta, to the left of the spine, was accomplished by inserting an opacified polyvinyl catheter into the femoral artery, up the descending aorta, to the left common carotid. The catheter, containing opaque medium, was demonstrable roentgenographically.

Anastomosis between the aorta and the pulmonary artery was successfully accomplished.

Two roentgenograms; 1 electrocardiogram; 1 photograph. MARSHALL B. TUCKER, M.D.
Oakland, Calif.

Congenital Pulmonary Stenosis Without Cyanosis. John J. Galligan, Forrest H. Adams, and Joseph Jorgens. J. Pediat. **41**: 562–571, November 1952.

Stenosis of the pulmonary valve may occur as an isolated lesion or in association with patency of the foramen ovale. Patients may be acyanotic throughout life or cyanotic only terminally.

Twenty-three cases of pulmonary stenosis without cyanosis were reviewed by the authors. The diagnosis was confirmed by cardiac catheterization in 17 patients and by surgery without catheterization in 3 patients; the clinical and laboratory findings in the 3 remaining cases were typical of the lesion. Twelve patients were males and 11 were females. Fifteen were under fifteen years of age; only 2 were over twenty and none were over thirty.

The onset of symptoms was rather insidious. In no instance did they develop until early childhood. Thirteen patients ultimately showed symptoms, including 3 over the age of fifteen; 10 were asymptomatic. Dyspnea on exertion was the typical complaint. Three patients experienced precordial pain on exertion. Another had only mild dyspnea but complained of recurrent palpitation and dizziness and subsequently experienced several episodes of paroxysmal ventricular tachycardia associated with heart failure. The growth and development of these patients appeared to be normal. Clubbing of the digits was uniformly absent. Only 3 patients had a precordial bulge of the chest. A systolic thrill was palpable in the pulmonary region in 15. A loud systolic murmur in the pulmonic region was present in every instance. The pulmonary second sound was decreased in intensity or obscured by the murmur in all but 1 patient.

Electrocardiograms revealed axis deviation greater than 90 degrees in 19 of the 22 tracings that were obtained. Evidence of right ventricular hypertrophy was present in 18 of the 20 patients with unipolar lead tracings. Right bundle branch block was evident in the tracings of 2 patients.

The typical roentgen findings in congenital pulmonary stenosis are: right ventricular hypertrophy; a disproportionate enlargement of the main pulmonary artery segment and the left root shadow as compared to the right root shadow; normal or slightly decreased diameter of the peripheral vascular markings. These characteristic findings were present in 16 of the authors' cases; in 6 the roentgen findings were suggestive, and in 1 the findings were atypical.

The right ventricle was enlarged roentgenologically in all patients. The main pulmonary artery was abnormally prominent in 22. A disproportionate enlargement of the left root shadow as compared to the right root shadow was present in 17. Twenty patients were considered to have normal peripheral vascular markings, and in 3 the markings were decreased.

Cardiac catheterization was performed in 17 cases, and in 16 the right ventricular pressure was found to be elevated.

In 11 cases surgery was undertaken in an attempt to relieve the stenosis of the pulmonary valve. There was one operative death. The remaining 10 patients appear to have benefited from surgery.

Six roentgenograms; 1 graph; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California

Myxoma of the Left Atrium. Diagnosis Made during Life with Operative and Postmortem Findings. Henry P. Goldberg, Frank Glenn, Charles T. Dotter, and Israel Steinberg. Circulation **6**: 762–767, November 1952.

Of approximately 350 cases of primary tumors of the heart reported in the literature, only 5 were diagnosed during life, and none by angiocardiography. The authors present a case in which the diagnosis was established angiocardiographically and an attempt was made to remove the tumor surgically [another "first," since surgical removal of a cardiac tumor has not previously been reported].

The patient was a child of 3 years with no history of rheumatic fever but with clinical signs of mitral stenosis and a history of 4 separate episodes of systemic embolization in the absence of auricular fibrillation. Left atrial tumor was suspected and diagnosed by a filling defect on the angiocardiogram. Surgery was at first postponed in the hope of obtaining some type of mechanical "heart", but finally, as the child's condition grew worse, operation was performed. The tumor was found to be occluding the mitral valve almost completely. Partial removal was done, but the patient died of cardiac arrest. Pathologically the tumor was a myxoma, with no sign of malignancy.

Four roentgenograms; 1 photograph; 1 photomicrograph; 2 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

Congenital Esophagobronchial Fistula in an Adult. Jacob K. Berman, Pasquale S. Test, and Bruce A. McArt. J. Thoracic Surg. **24**: 493–501, November 1952.

Communications between the respiratory tract and the esophagus are said to occur about once in every 800 births but are rarely seen in adult life unless they are acquired. The authors were able to find reports in the literature of only 4 proved tracheo- or bronchoesophageal fistulas in adults. They present a case in a 40-year-old colored woman, which is particularly unusual because the communication was between the esophagus and the basal bronchus of the left lower lobe. The case is also of interest in that there were associated vascular anomalies which may be important in the embryogenesis of such communications.

The patient had a life-long history of episodes of severe cough, choking, and vomiting, with associated chills and fever, weight loss, anorexia, and extreme weakness. She had been seen in many hospitals and clinics for recurrent pneumonia and chronic bronchiectasis. A diagnosis of tuberculosis had been considered several times, but acid-fast bacilli were not found. The authors obtained a bronchogram with Lipiodol which showed advanced saccular bronchiectasis in the left lower lobe. A barium swallow revealed a fistulous communication between the esophagus and the left lower bronchial tree.

In spite of the patient's poor condition, an exploratory thoracotomy was performed. A fistulous tract between the esophagus and basal bronchus of the left lower lobe was encountered. The fistula was well defined, measuring about 1.5 cm. in length and about 0.6 cm. in diameter. It was dissected out and removed close to the esophagus. Both the opening in the esophagus and that on the bronchial side were closed.

The postoperative course was gratifying, and eighteen days later pneumonectomy was performed, with removal of the whole left lung. This operation revealed, also, a patent ductus arteriosus, which had been suspected previously because of a machinery murmur, and an anomalous artery which arose immediately above and adjacent to the site of the fistula. The patient recovered and was released from the hospital twelve days later, much improved.

The microscopic report identified the fistulous tract as containing all the elements of true esophagus, including glandular structures. On the basis of this observation, it was decided that it was a true congenital communication.

The authors discuss the possibility that anomalous vessels may be important in the production of bronchoesophageal fistulas by interference with the complete separation of the esophagus from the trachea, which normally occurs about the fifteenth day of fetal life. They emphasize the fact that patients with a long history of persistent cough and repeated attacks of pneumonitis or pneumonia should have a careful workup, including barium study of the esophagus, to rule out such fistulas as well as pharyngoesophageal diverticula and other defects which might lead to regurgitation and aspiration.

Eleven roentgenograms; 4 photographs.

C. J. CORRIGAN, M.D.
St. Paul, Minn.

Congenital Tracheo-Oesophageal Fistula Without Atresia but With Large Oesophageal Diverticulum. Douglas Robb. Australian & New Zealand J. Surg. **22**: 120–122, November 1952.

The author reports a variation of the more frequent congenital malformations of the upper third of the esophagus encountered in newborn infants.

Vogt's (1929) classification recognizes the following types:

Type 1: Complete absence of the esophagus.

Type 2: Atresia with an upper and lower esophageal segment each ending in a blind pouch.

Type 3: Atresia of the esophagus with tracheoesophageal fistula (*a*) between upper segment and trachea; (*b*) between lower segment and trachea; (*c*) between both segments and trachea. Fistulas without atresia have also been described.

The author's patient, aged 11 years, with a history of coughing and choking after meals since birth, had a large diverticulum of the esophagus. The pouch was demonstrated by barium swallow, and was found to originate about 1 cm. above the tracheal bifurcation. At operation, in addition to the elongated diverticulum, there was found a fistula, just anterior to it, between the esophagus and trachea, with an oval opening of about 3 mm.

Both defects were corrected surgically, and the postoperative course was uneventful.

Two roentgenograms; one diagram.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Esophago-Gastric Invaginations. Raymond Sarasin. Radiol. clin. **21:** 391–394, November 1952. (In French)

The author presents a brief résumé of a case of esophagogastric invagination previously reported (Sarasin and Hoch: Schweiz. med. Wchnschr. **81:** 1207, 1951. Abst. in Radiology **60:** 123, 1953). The patient was a 54-year-old male with difficulty in swallowing. Radiologic examination revealed an hiatus hernia in which there was a filling defect, suggesting invagination of esophageal tissue into the hernia. The esophagoscopist reported a serrated stenosis at the lower end of the esophagus, probably due to neoplasm. Exploratory operation revealed invagination of the esophagus into a hiatus hernia.

Three types of esophago-gastric invaginations are mentioned. The first is the type described above, in which the esophagus invaginates into a hiatus hernia. Secondly, there is invagination of the esophagus through the cardia. Thirdly, a pedunculated tumor may prolapse through the cardia and draw part of the esophageal mucosa along with it. Such tumors are usually benign.

CHARLES NICE, M.D.
University of Minnesota

Sliding Hiatus Hernia. John A. Evans. Am. J. Roentgenol. **68:** 754–763, November 1952.

Hiatus hernias, excluding the rare congenitally short esophagus, are almost altogether of the paraesophageal and the sliding esophageal types, the latter occurring in 85 to 92 per cent of all cases examined by several groups. The fundamental distinguishing feature between the paraesophageal and sliding hernia is the location of the esophagocardiac junction, which in the latter type is pushed above the diaphragm, compromising the integrity of the closing mechanism at the gastric cardia and thus allowing a reflux of gastric juice into the lower esophageal segment with the production of esophagitis, ulceration and stenosis. These complications were present in 14.7 per cent of the author's series of 175 cases.

The historical background of the anatomical investigation of the lower esophagus is reviewed. The confusion and uncertainty in the minds of the anatomists is reflected by the difficulty the roentgenologist has in differentiating small sliding hiatus hernias from small clinically unimportant supradiaphragmatic dilatations. The distinction is frequently made not on the basis of roentgen anatomy alone, but rather on the recognition of a physiological defect, namely, the incompetence of the gastric cardiac sphincter with reflux of barium into the distal esophagus.

The responsibility of the radiologist for early diagnosis is stressed. Thus only can the complications mentioned, which may progress so far as to simulate a stenosing carcinoma, be prevented. Eary surgical correction of the abnormality is urged.

Fifteen roentgenograms; 3 drawings.

G. E. Ross, M.D.
Indiana University

Gastric Ulcer. Analysis of 221 Cases. Walter W. Vaughan and Robert J. Nichols. South. M. J. **45:** 1035–1043, November 1952.

Follow-up studies were obtained in 95 per cent of 221 cases of gastric ulcer collected from the files of a general hospital over a fifteen-year period. Frank ulcerating carcinomas and polypoid tumors of the stomach were excluded from the study. At the initial examination 13 of the ulcers were verified as malignant, and 208 were proved or suspected benign ulcers. The average duration of symptoms for all cases was six and a half years, with typical ulcer symptoms present in 63.5 per cent. The average size of the ulcer on the roentgenogram was 1.43 cm. in diameter. In 6.7 per cent of the benign group there were two or more gastric ulcers, and in 3 (23 per cent) of the malignant group. An associated duodenal ulcer was present in 20.7 per cent of the benign and in 2 (15.4 per cent) of the malignant group. No ulcer was situated on the greater curvature.

Follow-up of the 80 surgical cases showed 61 per cent of patients considered to be in excellent condition, 10 per cent in good condition, and 20 per cent in poor condition. Three died in the hospital and 4 within two years of operation. Of the 118 medically treated cases (10 had no follow-up, 4 died in the hospital of massive hemorrhage), 38 per cent were in excellent condition on follow-up, 22 per cent in good, and 22 per cent in poor condition. The follow-up periods ranged from less than two years up to ten years and more. Indications for surgery in 70 verified benign ulcers included carcinoma diagnosed or suspected in 40 per cent; ulcer not healed in 17 per cent; recurrence of ulcer in 13 per cent; hemorrhage in 10 per cent; obstruction in 8.6 per cent; intractability of symptoms in 8.6 per cent; perforation in 2.8 per cent. One operative and two postoperative deaths in the group in which subtotal resection was done gave an operative mortality of 5.4 per cent.

In the 208 cases diagnosed as benign, no check-up roentgenograms were obtained until the present follow-up study was begun, and 41 patients went over one year without any follow-up x-ray examination. The responsibility of the attending physician and the roentgenologist for adequate follow-up of all ulcerating gastric lesions, whether treated medically or surgically, is emphasized. The physician treating his patient medically should follow Jordan's criteria for benignity: complete disappearance of the lesion as demonstrated radiologically within eight weeks, disappearance of blood in the stools, disappearance of symptoms, absence of recurrence. Also suggested is follow-up x-ray

examination every six months for five years after healing of the ulcer.

Two illustrative cases are reported.

Sixteen roentgenograms; 4 photomicrographs; 10 tables.

W. A. NAFIS, M.D.
Jefferson Medical College

Incidence and Mechanism of Early Dumping Syndrome after Gastrectomy. A Clinical and Radiological Study. J. C. Goligher and T. Richard Riley. Lancet 1: 630–636, March 29, 1952.

It has been claimed that the incidence of the so-called dumping syndrome following gastrectomy can be influenced by the type of operation. In view of this, the authors undertook clinical and radiological observations on 224 patients to determine the incidence and mechanism of dumping after various types of total and partial gastric resection. The observations were made six months after the operation.

Dumping was found to occur in 168 (75 per cent) of the patients and to be severe in 28 (12.5 per cent). Spontaneous amelioration took place in time, and reassessment of 141 patients eighteen months after gastrectomy showed that, though 67 (47.5 per cent) still had dumping, it was severe in only 10 (7.1 per cent). The incidence of dumping was not related to the type of partial gastrectomy, but was slightly higher the more extensive the resection. In total gastrectomy (14 cases), dumping seemed much more frequent and severe than following the partial or subtotal procedures.

The most striking feature observed radiologically was that after all forms of partial and subtotal gastrectomy—in which the pyloric sphincter is sacrificed—the stomach remnant loses its power of active retention of food. The food passes immediately, under the influence of gravity, from the stomach into the duodenum or upper jejunum. The small intestine thus bears the weight of the meal, and duodenal or jejunal dilatation is frequently observed. It is this distention that is held to be responsible for the dumping symptoms.

Reflux of food into the afferent jejunal loop and duodenum is not regarded as especially important in the etiology of dumping, since after the Hofmeister-Finsterer type of gastrectomy such reflux is often avoided, yet the dumping syndrome is no less frequent than with the Polya-Moynihan procedure, which is nearly always followed by reflux. Similarly stretching of the gastric stump cannot be considered an important factor, since dumping often occurs after total gastrectomy. Whatever the precise mechanism, the bowel in time clearly acquires a tolerance to the distention in most cases. Radiologically, this was suggested by the frequent finding of permanent duodenal and upper jejunal dilatation, and clinically it is reflected in the gradual diminution of the symptoms.

In an addendum to their paper, the authors comment on recent operative procedures in which a transplanted segment of colon is used to provide a gastric reservoir following gastrectomy. They do not believe that this method of colon replacement either eliminates dumping or sufficiently minimizes it to warrant the added intricacy and increased danger of the procedure. In 4 of 15 cases in which they used this technic, there was delay, as shown radiologically, up to one and a half to two hours in the emptying of the stomach remnant and colon transplant, but in the remainder emptying was as rapid as in the more orthodox gastric resections.

Eight roentgenograms; 2 drawings; 1 table.

Diagnosis and Treatment of Pyloric Hypertrophy in the Adult. William P. Kleitsch. Arch. Surg. 65: 655–664, November 1952.

The author presents 4 cases of pyloric hypertrophy in the adult which were thought preoperatively to be either ulceration with stenosis or antral carcinoma. The symptomatology in these 4 patients did not follow any characteristic pattern. One patient obtained partial relief by vomiting which, if associated with aggravation by food, is thought by the author to be an important point in differentiation of hypertrophy from ulceration.

The author considers diagnostic errors in these cases unnecessary, since the roentgen appearance is typical, readily recognizable, and constant. The picture is that of an elongated and narrowed pyloric canal, the thickened sphincter muscle giving the impression of a filling defect surrounding the pyloric antrum. The elongation and narrowing of the pyloric canal is termed the "pyloric string sign." It is not obliterated by antispasmodics. [The radiographic differentiation between the narrowing produced by pyloric hypertrophy and that of a constricting antral carcinoma is not discussed.]

On surgical exploration, 3 patients showed an associated gastric ulceration and the fourth showed evidence of a recently healed gastric ulcer. The surgical treatment used was varied because of the presence of the associated ulcers. For the treatment of an uncomplicated (without ulceration) hypertrophy, a pyloroplasty or a Billroth I partial gastrectomy is indicated.

Four roentgenograms; 2 photographs; 1 photomicrograph; 2 diagrams.

DEAN W. GEHEBER, M.D.
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Transpyloric Prolapse of the Gastric Mucosa. Alfred A. de Lorimier and Claudius Y. Gates. West. J. Surg. 60: 571–578, November 1952.

The authors believe that there is a tendency for the medical profession generally to disregard prolapse of the gastric mucosa as a clinical entity. In their experience, it is one of at least ten relatively common findings which might account for peptic ulcer symptoms. They consider it a clinical entity in certain instances, and in others a corroborative finding of physiologic or organic disturbance.

Roentgenologically, there is usually excessive secretion in the stomach, and antral spasm and pylorospasm are to be expected. The changes are more likely to be recognized fluoroscopically with the right side down and forward. The typical feature is a "mushroom-like," "cauliflower-like," or "umbrella-like" filling defect in the base of the cap, with a central constricted column of barium.

This condition must be differentiated from antral or pylorospasm without prolapse, hypertrophy of the pyloric muscle, ulceration at the pylorus, prepyloric carcinoma, prolapsing polyp, duodenitis, and duodenal ulcer.

The authors conclude that the great majority of cases will respond to medical management. Severe cases should be handled surgically.

Five cases are reported to illustrate some of the problems, diagnostic and therapeutic, associated with this condition.

Six roentgenograms.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Recognition of Functional Disorders of the Small Intestine. A. Morton Gill and Elizabeth de C. Falle. Lancet **2**: 356–360, Aug. 23, 1952.

Functional disorders of the intestine are often unrecognized or are attributed solely to the colon (colon spasm, irritable colon, functional or motor disorder of the colon). In the authors' experience, many of the features described as colon spasm are found when the small intestine is involved.

Eight cases of intestinal dysfunction affecting the ileum in particular (0.53 per cent of 1,500 new patients with gastrointestinal complaints attending the Gastric Clinic of West London Hospital in a three-year period) are reported. Colon spasm alone is ten times more common and is closely related to manifest anxiety. It presents a well defined clinical picture and responds well to reassurance, belladonna, and phenobarbitone. The ileal syndrome is less obviously psychosomatic in origin, has a more complex symptomatology, and has proved resistant to treatment.

In 1 of the authors' 8 cases there was associated colon spasm. The main features of the other 7 cases were:

1. All patients were women who had never been pregnant and whose symptoms had begun during the childbearing period, the length of history averaging more than nine years. Dysmenorrhea was a common complaint.
2. All the patients had abdominal pain, poorly localized, often radiating to the sacrum, groins, or down the front of the thighs. The pain tended to be aggravated by menstruation and defecation but was unaffected by food, holidays, antispasmodics, or rest in the hospital.
3. All had disordered bowel action; abdominal distention was commonly severe and nausea was frequent.
4. All were energetic and overly conscientious, with average to good intelligence. They held fairly responsible jobs. Their personalities were immature but they had adapted well to their life situations.
5. All had had laparotomies for their symptoms and in none had any organic change been found in small or large bowel.
6. Clinical examination revealed abdominal distention and tenderness with variable spasticity of the colon. Roentgen examination of the intestines showed spasm, mucosal thickening, hypermotility, or a deficiency pattern, the ileum being consistently affected.
7. Inconstant features included pyrexia (4 cases) during the attacks, bladder disturbances (5 cases), evidence of poor peripheral circulation (3 cases), and allergic manifestations (3 cases).

Eight roentgenograms; 5 drawings.

The Diagnosis of Intestinal Obstruction in the Newborn. Ambrose Jolleys. Brit. J. Surg. **40**: 201–210, November 1952.

The diagnosis of obstructing intestinal lesions in the newborn should present no difficulty. The cardinal symptoms are bilious vomiting, abdominal distention, and abnormal bowel action. Once the suspicion of obstruction is raised, it is easy to confirm or disprove the suspected diagnosis by plain radiography. The important thing is to determine, before surgery is undertaken, just what is causing the obstruction and its approximate site. Eighteen cases are reported, representing different obstructing mechanisms, most of them peculiar to the early postnatal period and of developmental origin.

Four cases were due to anomalies of intestinal rotation. Such anomalies predispose to volvulus, with rotation of the small bowel about the superior mesenteric artery as an axis. Often a second obstructing lesion is present in the form of peritoneal bands running from the cecum to the right side of the abdomen across the second portion of the duodenum. The x-ray picture is that of duodenal obstruction, usually a little lower than in duodenal atresia. As volvulus often develops a short time after birth, blood is sometimes passed in the stool, and microscopy will show stratified epithelial cells in the meconium.

Atresia is represented by 2 cases. It may occur at any level, with the result that the signs and course of events vary somewhat. Vomiting usually begins immediately after birth, and roentgen examination shows that air has not progressed into the small bowel. Obstruction due to atresia can be differentiated from that due to malrotation by the early onset of symptoms and the absence of squamous epithelium (vernix) from the meconium.

Six cases of neuromuscular dysfunction were observed. This is due presumably to a lack of ganglion cells in the bowel wall, resulting in spasm of the involved segment and obstruction. If the obstruction is in the colon, diagnosis is easy. There may be a family history; the symptoms are rather slow in onset, and gross distention of the abdomen with a typical colonic pattern occurs. Confirmatory evidence is obtained by running a little barium into the colon. Water intoxication, however, is a real threat in these cases, and if an enema is given, as much fluid as possible should be siphoned back.

If there is lack of ganglion cells in the ileum, then the mode of onset, the central distention, and the plain films give a picture of ileal obstruction. A family history or the presence of cornified cells in the stool will differentiate such a case from atresia, and the presence of trypsin in the vomitus will exclude meconium ileus.

Meconium ileus is another condition to be considered. It is represented by 3 cases in this series. Several clues may suggest the diagnosis. The author mentions particularly absence of trypsin in the vomitus, as determined by its failure to digest the gelatin from a piece of x-ray film within an hour, and the roentgen demonstration of small air bubbles outside the obviously distended loops of bowel. [He fails to make mention of intra-abdominal calcification.]

Internal hernias, peritoneal bands, and other miscellaneous causes of obstruction are to be found in the newborn. Three cases of such origin complete the series.

Finally, it is pointed out that other causes of vomiting in early infancy must be considered, as increased intracranial pressure, pylorospasm, pyloric stenosis, and esophageal atresia.

Nine roentgenograms; 5 drawings; 1 photograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Regional Ileitis. A Pathological and Clinical Entity. Burrill B. Crohn, Leon Ginzburg, and Gordon D. Oppenheimer. Am. J. Med. **13**: 583–590, November 1952.

Regional ileitis is a disease of the terminal ileum characterized by a subacute or chronic necrotizing and

cicatrizing inflammation, affecting chiefly young adults. The ulceration of the mucosa is accompanied by a disproportionate connective-tissue reaction of the remaining wall of the involved intestine, a process which frequently leads to stenosis of the lumen associated with multiple fistula formation. The etiology of the condition is unknown. It belongs in none of the categories of recognized granulomatous or accepted inflammatory groups.

The present review is based upon 14 cases in which careful clinical observations were supplemented in 13 instances by study of resected specimens. The symptoms resemble those of ulcerative colitis, consisting of fever, diarrhea, and emaciation, with eventual obstruction of the small bowel. Four clinical types or phases are recognized: (1) acute intra-abdominal disease with peritoneal irritation; (2) symptoms of ulcerative enteritis; (3) stenotic phase; (4) persistent fistulas.

Roentgenologically, definite findings are demonstrable by a barium meal study. These usually include distended loops of terminal ileum, in which a fluid level is discernible, and a definite delay in passage of the meal through the distal portion of the small intestine. Milder degrees of ileal stasis and puddling in the ileal loops may easily be overlooked or, even when plainly indicated, may not be properly evaluated. In the presence of a fistulous communication with the ascending colon, there may be some stricture deformity of the latter or of the hepatic flexure, with delayed motility at that point. When the sigmoid is similarly involved in a fistulous tract, a true narrowing and delay at this flexure may simulate carcinoma and so create the necessary indication for operation. Except in the presence of a fistula, the colon is uninvolved, in spite of the fact that the ileocecal valve usually shows the most advanced pathologic changes.

The authors favor surgical resection of the diseased segment of the small intestine and of the ileocecal valve with its contiguous cecum. In 13 of their 14 patients complete restoration of health followed radical resection or a short-circuiting operation.

Primary Carcinoma of the Third Portion of the Duodenum. Lennart Kjellman. Acta radiol. **38**: 273–278, October 1952.

A single case of primary carcinoma of the third portion of the duodenum below the ampulla is described, with the microscopic findings. The author reviews the literature with emphasis on the rarity of carcinoma in this portion of the duodenum and the difficulties of establishing a diagnosis. The roentgenographic evidence corresponds to the pattern usually seen in primary carcinomas of the small intestine. One may observe all degrees of central or eccentric constriction of the lumen, rigidity of the walls over an area corresponding to the extent of the tumor, obliteration of the normal mucosal markings, and an irregular outline in the involved region. The intestinal segment proximal to the tumor often displays either compensatory hypertrophy or secondary dilatation.

Two roentgenograms; 1 photograph.

JAMES E. LOFSTROM, M.D.
Detroit, Mich.

Obstructive Perforation of the Cecum. Report of Eight Cases. Frank J. Rack. Am. J. Surg. **84**: 527–532, November 1952.

In the records of Cleveland City Hospital for the years 1940 through 1950 there were 8 cases of proved obstructive perforation of the cecum available for study. Five of the 8 patients were admitted to the hospital with a diagnosis of perforated viscus. In 1 case the perforation occurred shortly after admission, and in the remaining 2 it followed surgical decompression for large bowel obstruction, cecostomy in one case and transverse colostomy in the other.

Most of the patients admitted with perforation reported a gradual development of abdominal distress over a long period of time. The chronic phase was usually followed by an acute episode of seven days or less. In the 4 patients admitted with perforation and peritonitis the signs were mild and not suggestive of so serious a condition. The most significant physical findings were marked abdominal distention and moderately severe abdominal tenderness.

Typically, roentgenograms of the abdomen in the presence of a ruptured cecum secondary to obstruction reveal: (1) tremendous quantities of air under the diaphragm, (2) greatly distended loops of colon, especially cecum, and (3) considerable distention of the small intestine.

The management of the patient in whom perforation of the cecum has occurred is a difficult problem. In 2 of the cases studied by the authors, exploratory laparotomy was done, but both terminated fatally. The manipulation of distended bowel through a large laparotomy incision in a contaminated peritoneal cavity seems contraindicated. The safest course appears to be exploration through a small right lower quadrant incision. If a perforation is found, a Pezzer catheter should be placed in it or the cecum should be exteriorized, without further exploration.

Six roentgenograms; 3 tables.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Diverticulitis of the Cecum. Edward E. Jemerin. Surgery **32**: 863–868, November 1952.

A case of diverticulitis of the cecum diagnosed preoperatively by roentgen examination is reported. When an abdominal mass was felt on clinical examination, a foreign body such as a gauze sponge was suggested. This seemed to be borne out by the globular shadow seen in the plain film. With the barium-enema study, however, the true nature of the shadow was demonstrated.

One roentgenogram.

Calculi in the Appendix. L. P. Clark. Brit. J. Surg. **40**: 272–273, November 1952.

The author reports a case in which a large, roughly cuboidal laminated stone and a smaller star-shaped one were found in an appendix greatly thickened and chronically but not acutely inflamed. Pyelography proved the stones to be outside the urinary tract.

Felson and Bernhard (Radiology **49**: 178, 1947) are cited as stating that the diagnosis of appendiceal calculi is dependent upon the roentgen findings. If calculi in the right lower quadrant can be shown not to be in either the ureter or a low-lying gallbladder, they must be in the appendix. Calcified lymph nodes have a granular, fragmented appearance in contrast to the laminated or star shape of stones.

[True calculi in the appendix are seldom diagnosed preoperatively because in most hospitals a routine preoperative abdominal film is not usually obtained in

patients with symptoms suggestive of appendicitis. Nor is the condition frequently thought of. The question is more or less academic, since surgery is indicated in appendicitis whether or not calculi are present, but precision in diagnosis is always to be desired.—Z. F. E.]

One roentgenogram; 2 photographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Experience with a New Cholecystographic Medium (Telepaque). Francis M. Spencer. Gastroenterology **21**: 535–539, August 1952.

A comparison was made of the side-effects and the quality of gallbladder visualization in 125 patients receiving Telepaque and 100 receiving Priodax. Those taking Telepaque were given 4 tablets (2 gm.) and those receiving Priodax were given a total of 9 tablets (4.5 gm.). No attempt was made to select patients on the basis of weight, history, sex, or other criteria. Larger patients and those with former unsatisfactory visualization with other agents were given 6 tablets (3 gm.) of Telepaque. Radiographic studies were made from twelve to fourteen hours following the ingestion of the radiopaque medium.

Only 20 per cent of those receiving Telepaque experienced side-effects, two-thirds of these being so mild as to be of little consequence. In only 5.6 per cent were the side-effects—nausea, vomiting, diarrhea, or dysuria—of sufficient severity to cause significant distress or to interfere in any way with a satisfactory examination. Many patients previously examined with Priodax and experiencing severe side-effects tolerated Telepaque without discomfort.

A higher incidence of dense gallbladder shadows was obtained with Telepaque. The author's impression was that in most instances the smaller dose of this medium (2 gm.) resulted in a satisfactory gallbladder shadow, not too dense to obscure small non-opaque calculi, but that for patients weighing over 150 pounds a 3-gram dose is indicated. Because of the slighter chance of losing contrast material from the gastrointestinal tract, due to the lower incidence of side-effects, satisfactory gallbladder visualization is more apt to be obtained with Telepaque.

Following a fat meal, 92 per cent of patients receiving Telepaque exhibited satisfactory gallbladder emptying, whereas satisfactory contraction was obtained in only 64 per cent of those receiving Priodax. It is postulated that the failure to obtain adequate gallbladder contraction with Priodax is due to its irritating properties, resulting in a spasm of the sphincter of Oddi or other parts of the biliary duct system.

Three tables.

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Ohio State University

Studies on Cystic Fibrosis of the Pancreas. Role of Various Diluents and the Dilution Factor in the Interpretation of the X-Ray-Film Test for Fecal Trypsin. Douglas E. Johnstone. Am. J. Dis. Child. **84**: 191–198, August 1952.

The results of the investigation of various diluents and the dilution factor in the interpretation of the x-ray film test for fecal trypsin are presented. It has been previously observed that falsely positive tests for fecal trypsin due to bacterial gelatinase were obtained in more than one half of 137 children with cystic fibrosis of the pancreas whose feces were tested by the x-ray-film technic (Johnstone and Neter: Pediatrics **7**: 483, 1951). Also, fecal trypsin studies on children with fibrocystic disease of the pancreas indicated that a falsely positive test due to bacterial gelatinase might be excluded if the test specimen liquefied the gelatin coating of the x-ray film in a dilution of 1:120 or higher.

The film technic was used in 9,600 tests for fecal trypsin, performed on 963 specimens from 216 children without evidence of intestinal disease. Of postmeconium specimens thus tested, 96 per cent gave positive results for fecal trypsin in a dilution of 1:96 or higher. Of children under five years of age, 92 per cent gave positive tests in the dilution of 1:192 or higher. Gelatin-liquefying bacteria were found in one-third of the specimens. Premature infants proved to be able to handle protein efficiently and did not have an immature and inferior protein-splitting capacity of the intestinal tract, as had been previously suggested.

Four different diluents were tested in various dilutions, but sterilized distilled water was utilized as a diluent for most of the tests. It was found that different diluents when exposed to room air for various time intervals developed a higher *p*H and a higher gelatin-liquefying capacity.

A complete description of the method utilized in the performance of the x-ray film for fecal trypsin is presented.

Four tables; 3 charts.

JACK WIDRICH, M.D.
Ohio State University

Meconium Peritonitis Due to a Hole in the Foetal Intestinal Wall and Without Obstruction. Alfred White Franklin and John P. Hosford. Brit. M. J. **2**: 257–259, Aug. 2, 1952.

The authors report 2 cases of meconium peritonitis with a defect in the intestinal wall but without intestinal obstruction at the time of the peritonitis or subsequently. Both patients recovered following surgery.

The mechanism whereby meconium reaches the peritoneal cavity is something of a mystery. Rupture of the intestinal wall may occur in association with obstruction, but it has been shown that a hole may occur in the absence of obstruction and cases have also been reported in which a careful postmortem examination has failed to demonstrate any defect through which the meconium could have spilled into the peritoneal cavity. A complete explanation for these observations is lacking but the authors postulate that in a fetus with meconium ileus the intestine may perforate as a result of vigorous peristalsis, the meconium passing into the peritoneal cavity, thereby relieving the obstruction, and, furthermore, that the perforation may even heal in some cases before birth.

In the two cases presented, the intestines were found to be heavily embedded in a thick fibrin layer. In one case there was marked calcification in the parietal and visceral peritoneum at birth; in the other, calcification appeared during the course of observation. In neither case was there evidence of obstruction.

Four roentgenograms.

JACK WIDRICH, M.D.
Ohio State University

THE MUSCULOSKELETAL SYSTEM

Further Observations on "Corticalisosteoide" or "Osteoid Osteoma." Erik Moberg. Acta radiol. **38**: 279–293, October 1952.

The author reports 4 cases of osteoid osteoma: 2 in

metatarsals, 1 in a phalanx of the toe, and 1 in the tibia, all proved by surgery and histologic examination. He has previously published 8 cases of this entity, which he prefers to call "corticalisosteoide" (Arch. f. klin. Chir. **202**: 553, 1941). In his discussion he rejects the opinion that the disease may be a form of bone abscess. He is also in disagreement with Jaffe's concept of the process as a form of benign tumor, since reports have appeared of cases which, though not treated surgically, have finally become asymptomatic, with gradual improvement in the roentgen findings. No new idea as to etiology or pathogenesis of these lesions is offered, however.

The radiographic diagnosis is covered quite thoroughly, with emphasis on differentiation from cortical bone abscess, syphilitic osteoperiostitis, and "xanthomatous tumor" of bone (eosinophilic granuloma). The important differential point, when the lesion involves a long bone or short "tubular" bone, is the dense and extensive cortical sclerosis which is out of all proportion to the size of the nidus of decreased density representing the osteoid osteoma, and which is not seen to this extent in the other conditions. In spongy bone the surrounding sclerotic bone reaction is less marked, or may be altogether absent, while the central nidus is of varying density.

Fourteen roentgenograms; 2 photomicrographs; 1 drawing.

MAURICE TATELMAN, M.D.
Detroit, Mich.

Epiphyseal Separation as the Cause of Abnormal Remodelling of Bone (Formation of an "Umbauzone"). Johannes Thoms. Acta radiol. **38**: 307–312, October 1952.

Two cases are presented illustrating the mechanism of acute bone atrophy as seen following epiphyseal injury. In one case there was a complete displacement of the distal ulnar epiphysis, and in the other a probable injury to the epiphyseal plate of the distal tibia with epiphyseal separation but without dislocation. In both there later developed a pronounced widening of the epiphyseal line, due presumably to failure of the newly formed osteoid at the metaphysis to ossify in normal manner. This has been attributed to injury to the capillary loops at the metaphyseal-epiphyseal junction. A relationship is suggested to the changes seen in "march" fractures, Looser's lines in rickets, and such generalized diseases as syphilis, scurvy, osteomalacia, etc., and even the early findings of slipped capital epiphysis of the femur.

Eight roentgenograms.

MAURICE TATELMAN, M.D.
Detroit, Mich.

Some Observations on Bone Growth, with Particular Respect to Zones and Transverse Lines of Increased Density in the Metaphysis. Richard H. Follis, Jr., and Edwards A. Park. Am. J. Roentgenol. **68**: 709–724, November 1952.

A group of diversified disturbances in bone formation in children and experimental animals is presented, with particular attention to the histopathologic and roentgenographic appearance of zones or transverse lines of increased density in the metaphyseal regions. It is pointed out that bone disease in general may be classified on the basis of disturbances in three normal phenomena: chondroblastic activity, osteogenic-osteolytic balance, and deposition of inorganic materials in cartilage matrix and/or osteoid.

A sharp demarcation is made between zones of increased density at the ends of bones and transverse lines of increased density. The pathogenesis may be quite different. Zones of increased density result from an overproduction and usually associated failure of destruction of calcified cartilage matrix material. Transverse lines of increased density, on the other hand, result in large part from bone formation in a horizontal plane, along the under surface of the cartilage. The mechanisms operating to produce zones and lines may operate together, but more frequently the pathogenesis of the two is separate.

Many excellent reproductions of the histologic and roentgenographic appearances of the zones and lines are included.

Twenty-four roentgenograms; 27 photomicrographs.

HAROLD R. GRIFFITH, M.D.
Indiana University

Roentgen Diagnosis of Periarthrosis and Periarthritis. A. Leb. Fortschr. a. d. Geb. d. Röntgenstrahlen **77**: 525–534, November 1952. (In German)

Roentgen examination of the periarticular alterations may furnish valuable data for the differential diagnosis of intra- and periarticular lesions. Flat films will demonstrate the periarticular soft parts if the films are exposed with slightly higher voltage than would ordinarily be employed and are underdeveloped. Fibrosis, degeneration, widening and condensation of various periarticular connective-tissue structures, along with blurring of the muscle shadows may be observed. Opaque media may demonstrate alterations in the periarticular synovial bursae and in the parafascial spaces, as well as secondary changes in the articular cavities. Reabsorption of intra-articular contrast medium is delayed in periarthrosis, if the lymph and blood supply is disturbed. It is accelerated in acute hyperemic periarthritis. Joduron is absorbed normally within two hours. Arteriography may show diminished collateral circulation in cases of periarticular fibrosis.

Thirteen roentgenograms.

LEWIS L. HAAS, M.D.
Chicago, Ill.

Osteoarthropathy in Syringomyelia. Analysis of Seven Cases. J. Skall-Jensen. Acta radiol. **38**: 382–388, November 1952.

During the period from 1929 to 1952, 22 patients were treated for syringomyelia in the Department of Radiology and the Radium Centre of the County and City Hospital of Odense, Denmark. The ages ranged from sixteen to seventy-two years, with the age at onset of symptoms varying from thirteen to fifty-four years. Seven of these patients had osteoarthropathy. In 1 patient both elbow joints were involved and in another one elbow; one shoulder was involved in 5 cases. Histories of 2 patients are presented, with reproductions of films showing periarticular soft-tissue swelling and extensive bone destruction.

In the past, articular destruction in syringomyelia has been attributed to mechanical wear occurring to an abnormal extent because of the loss of sensibility in the joint. The author believes that there are two factors which would invalidate this view: (1) Affected joints are painful in about 50 per cent of cases of syringomyelia, and (2) the destruction may develop very rapidly with-

out any antecedent trauma. He believes that the most plausible explanation is that, due to progressive destruction in the spinal cord, vascular changes occur in and around the joint, ultimately leading to osteoarthropathy. The balance of sympathetic innervation may be disturbed locally for a time and thus the vascular changes may represent a transitory condition.

In describing the roentgenographic appearance of this type of osteoarthropathy the author notes that in the early stage of the disease there is soft-tissue swelling but no demonstrable bone change. Gradually there are extensive destruction in the joint and calcifications in the soft tissues. Later progressive bone atrophy and incipient absorption of the calcifications occur, accompanied by osteophyte formation. Finally, the osteophytes are partially absorbed.

Three roentgenograms. BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Roentgen Symptoms of Vitamin D Intoxication in Childhood. W. Swoboda. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 534–545, November 1952. (In German)

Thirteen cases of Vitamin D intoxication were observed and analyzed radiologically. The roentgen signs may be divided into three groups: (1) calcifications in bones and soft tissues; (2) osteoporosis; (3) periosteal reactions.

(1) Calcifications may appear as (*a*) a wide, dense zone of hypermineralization in the metaphyseal end of the bone; (*b*) multiple "year rings"; (*c*) intracranial calcification in the falx, tentorium, and retrosellar dura, and (*d*) soft-tissue calcifications, e.g., in vascular, periarticular, lung, and kidney structures.

(2) Osteoporosis is seen only in advanced stages, in the center of the bony structures.

(3) Periosteal widening and cortical hyperostosis are more frequent, occurring mainly in the metacarpals.

Individual disposition and constitutional and nutritional factors play an important role in the development, degree, and appearance of the clinical and roentgenologic signs.

Fourteen roentgenograms; 1 table.

LEWIS L. HAAS, M.D.
Chicago, Ill.

Mobility of the Upper Cervical Spine in Health and Disease. Edward H. Townsend, Jr., and M. Laurens Rowe. Pediatrics **10:** 567–574, November 1952.

Four cases were observed in which forward subluxation of the 2nd cervical vertebra in relation to the 3rd occurred in the course of an upper respiratory infection. The subluxation was accompanied by pain, muscle spasm, and visible deformity. Following traction and treatment of the respiratory condition the pain and muscle spasm were relieved but the displacement of the vertebra could still be demonstrated on films made in flexion.

The authors then examined a group of children without respiratory infections and demonstrated forward subluxation of C_2 on C_3 on flexion films in a number of cases. They concluded, therefore, that such displacement is a normal variant under eight years. It came to attention in the cases reported when the muscle spasm from respiratory infection caused the neck to be held in flexion during roentgen examination.

Ten roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Discography. J. H. Marchand and J. Levernieux. J. de radiol. et d'électrol. **33:** 662–664, 1952. (In French)

For demonstration of the intervertebral disks, the authors use a water-soluble compound, sodium monoiodo-sulfate. For examination at the L4-5 level or above, the patient lies prone, and a needle of large caliber is introduced from the posterolateral aspect to the bony margin of the vertebra. Through this needle is passed a longer needle of smaller caliber which enters the disk. For the L5-S1 level the patient lies on his side, a trocar is passed through the iliac bone, penetrating to the vertebral margin. The needle of smaller caliber is then introduced through the trocar into the disk.

The normal disk admits only a small amount of opaque substance, confined to the central portion, is not painful on injection, and shows a double-linear shadow on the roentgenogram. The degenerated disk shows fissures spreading in various directions and admits more contrast medium. In some cases the fissure spreads posteriorly beyond the margin of the vertebral body so that a herniation may be suspected. Injection of such a disk may produce pain. Degeneration of the disk may play a role in production of osteophytes and in "retrolisthesis," noted between two adjacent vertebral bodies.

A total of 101 disks were injected in 72 patients. Two complications were noted. In 3 cases the radiopaque liquid spread through a posterior fissure to irritate the meninges. In 9 patients with small fissures backache appeared on the eighth to tenth day following the procedure. This may be due to a diskitis caused by irritation produced by the contrast medium.

Three roentgenograms; 2 drawings.

CHARLES NICE, M.D.
University of Minnesota

Misdiagnosis and Mismanagement of Early Intervertebral Disk Lesions. L. Stanley Sell. J. A. M. A. **150:** 987–990, Nov. 8, 1952.

The author is of the opinion that low back pain is often the result of certain occupational hazards and that disk lesions are frequently misdiagnosed and subsequently mismanaged by general practitioners and others unfamiliar with certain fundamentals of orthopedic practice. Manipulative treatment may give relief in early disk lesions, but this theory of treatment does not recognize the underlying pathology and thus affords no opportunity for natural healing. Furthermore, such treatment definitely aggravates the fully established condition and frequently ruptures disks previously only herniating or bulging.

For a correct diagnosis in a case of suspected disk lesion, all the information possible should be obtained. After a history of occupation, duration of complaint, frequency of attacks, and former methods of therapy is taken, a physical examination should be done with attention to the following points: posture, leg lengths, pelvic tilt, curves, list, motion, muscle spasm and tenderness, response to Lasègue's and Gaenslen's maneuvers, reflexes, etc. Signs to be looked for are loss or reversal of lumbar curve on standing, limited and painful motion of the spine with the pain radiating down the legs, localized tenderness over a spinous process, a positive Lasègue's sign, depression or absence of ankle and knee jerks, and hypesthesia.

Roentgenologic examination may show normal find-

ings early in the process. Later one may see narrowing of the intervertebral space, subluxation of the facets, posterior marginal lipping, and posterior displacement of the intervertebral body above.

The author describes in some detail his method of treatment, discussing mental preparation of the patient, physical methods of care, medication and heat, postural exercises, casts and braces, rehabilitation. He suggests more complete instruction to fellow physicians who are not orthopedists and to lay groups, who always welcome medical information.

Five illustrations. MARSHALL B. TUCKER, M.D.
Oakland, Calif.

The Roentgenologic Diagnosis of the Sacroiliac Joints. J. E. J. Resink. Acta radiol. **38**: 313–322, October 1952. (In German)

The anatomy of the sacroiliac joints and the x-ray positioning for their optimum visualization, especially for a more accurate diagnosis of Bechterew's disease, are discussed. Measurements of 500 sacroiliac joints showed that there is no fixed angle to which the pelvis can be rotated to give optimum visualization of the joints. There is considerable individual variation as well as variation and asymmetry between the right and left sides. The greatest angle to which the patient had to be rotated was 37° and the least was 3°. It is recommended that patients be positioned under fluoroscopic control for each joint.

A final diagnosis of sacroiliac disease on an anteroposterior projection alone is not recommended, since such diagnoses may be shown to be incorrect in oblique projections made under fluoroscopic guidance. Four projections of each sacroiliac joint are obtained.

Results of examination in 350 patients (ages eighteen to seventy-four years) are reported. The x-ray findings were compared with the clinical findings only after a radiologic diagnosis had been established. In 14 patients the x-ray showed no changes, whereas the clinical findings were more or less definitely indicative of Bechterew's disease. In 10 patients there were x-ray changes of Bechterew's disease although no early clinical findings were present.

Twenty-one roentgenograms; 1 drawing.
PETER P. WERLE, M.D.
Detroit, Mich.

Osteitis Pubis and Its Treatment with Roentgen Rays. H. R. Renfer. Radiol. clin. **21**: 362–376, November 1952. (In German)

In the last few years a new malady has been observed following operations close to the pubic bones. There is usually an interval of two to twelve weeks between the operation and the onset of symptoms. Extreme pain is the earliest sign, at first localized to the symphysis pubis, but later extending toward the inner side of the thigh and the scrotum. Most of the muscles inserting on the pubic bones, especially the rectus abdominis and the adductors, show spasticity with marked tenderness. Neuritis of the obturator nerve with hyperesthesia of the inner side of the thigh is usually also present. The period of extreme pain lasts four to six weeks, but a considerable amount of pain is still present for another eight or nine months.

In the beginning there are no x-ray evidences of disease. About a week after onset of symptoms, however, roentgenograms show a blurring of the medial contours of the symphysis with irregular osteoporosis in the cartilaginous sections and a widening of the interspace of the symphysis. In mild cases the atrophy is confined to the symphysis, but in severe cases it extends to the ischial tuberosities.

After two to eight months, recalcification slowly sets in, often leading to massive sclerosis. As an end-result there is in most instances a thickening and condensation of the pubic bones, especially in the parts close to the symphysis.

In the differential diagnosis, osteomyelitis and osteolytic metastases have to be considered in the acute stage. In the later stages, the sclerosis can easily be mistaken for osteoplastic metastasis as seen in carcinoma of the prostate gland. Tuberculosis and syphilis must also be considered.

Osteitis pubis has been observed following bladder operations, especially in the presence of infection. The possibility of mechanical trauma in supra- and retropubic operations is discussed.

Therapy should consist of high doses of vitamin B^1 and B complex with roentgen irradiation. Leucutia in 1951 recommended roentgen therapy as reducing the duration of symptoms to half the usual time (Am. J. Roentgenol. **66**: 385, 1951. Abst. in Radiology **59**: 309, 1952.)

In the past two years the author had observed 5 cases, of which 4 were treated by irradiation. The patient who received no irradiation was symptom-free after four months. In the others regression of the pain was observed after the second or third treatment and symptoms had completely disappeared after periods ranging from two weeks to two months. The concentration of the irradiation in a relatively short time (two weeks) is held to be an important feature of the treatment and it is believed that it may play a significant role in the favorable results.

Seven roentgenograms; 3 graphs.
HERBERT POLLACK, M.D.
Chicago, Ill.

Hip Joint Arthrography. Gilbert W. Heublein, Gerald S. Greene, and Victor P. Conforti. Am. J. Roentgenol. **68**: 736–748, November 1952.

Opaque arthrography of the hip joint is often valuable in solving selected orthopedic problems in children. Conventional roentgenograms prior to the age of six or eight months afford little or no information regarding the radiolucent cartilaginous portions of the hip joint. In cases where the ossific capital nucleus is not demonstrated by roentgen study, it is sometimes impossible to tell whether or not one is dealing with luxation, subluxation, or a normally conjugated femoral head.

An outline of the technic of arthrography used by the authors and of the roentgen anatomical appearances of normal and abnormal hips is given. Arthrography of the hip joint probably finds its widest application in congenital dislocation of the hip: first, to determine whether the hip is subluxated or dislocated, and after manipulation to determine accurately whether or not reduction was successful.

The authors have used Diodrast arthrography in 40 cases since June 2, 1948, without constitutional reactions or unusual sequelae. Five specific case reports clearly demonstrate the advantages of this technic over routine film studies.

Twenty roentgenograms; 2 drawings.
HAROLD R. GRIFFITH, M.D.
Indiana University

Posterior Dislocation of the Shoulder. Report of Six Cases. R. G. Taylor and P. R. Wright. J. Bone & Surg. **34-B:** 624–629, November 1952.

The important clinical signs of posterior dislocation of the shoulder are the adducted and medially rotated position of the arm, a hard mass posteriorly below the acromion, representing the displaced humeral head, and limitation of movement, especially abduction and lateral rotation. In 4 of 6 cases reported by the authors a diagnosis could be made clinically but in 2 cases the dislocation was not recognized at the first examination, confirming the statement of others that posterior dislocation is easily missed.

The value of the vertical projection in the radiography of suspected posterior dislocation is emphasized. In the authors' cases anteroposterior views were inconclusive.

Reduction was accomplished without difficulty in 5 cases and the subsequent progress of these was uneventful. In the remaining case reduction was difficult and unstable, and the final recovery incomplete.

Eleven radiographs are presented.

ABRAHAM J. NICHOLAS, M.D.
Shreveport, La.

Fibrosarcoma Occurring in a Chronic Bone Sinus. W. Waugh. J. Bone & Joint Surg. **34-B:** 642–645, November 1952.

Whereas carcinoma is a well recognized complication of a chronic bone sinus, the occurrence of a complicating fibrosarcoma is unusual. The author reports such a case in a 66-year-old man who had a chronic discharging sinus on the outer aspect of the left thigh, of forty-eight years duration. Osteomyelitis had complicated an old knee injury. Three months prior to admission, a rapidly growing tumor had appeared at the sinus site.

Radiographs disclosed a large cavity in the lower end of the femur, and biopsy showed fibrosarcoma. Pathological examination after an above-knee amputation revealed that the tumor extended through the muscles into the bone. There was an irregular osteomyelitic abscess in the lower end of the femur. Histologic studies were in agreement with the biopsy report.

The patient improved rapidly but died suddenly two months later with symptoms suggesting a severe gastrointestinal hemorrhage. Consent for an autopsy was not obtained.

One roentgenogram; 2 photographs in color; 2 photomicrographs. WINSTON C. HOLMAN, M.D.
Shreveport, La.

"Aviator's Astragalus." W. D. Coltart. J. Bone & Joint Surg. **34-B:** 545–566, November 1952.

The rarity of the more severe and complicated injuries of the talus has resulted in a dearth of accurate descriptions and classifications in the literature. The author has reviewed a series of 228 injuries occurring in members of the British Royal Air Force between 1940 and 1945, which he classifies as follows:

Fractures	
Chip and avulsion fractures	56
Compression fractures of the head	6
Fractures of the body	15
Fractures of the neck	37
Fracture-dislocations	
Fracture of body with subtalar dislocation	7
Fracture of neck with subtalar dislocation	38
Fracture of neck with posterior dislocation of body	31
Dislocations	
From ankle, subtalar and midtarsal joints	9
Miscellaneous injuries	11
Dislocation of tarsus at subtalar joint	18

Such injuries have been collectively designated as "aviator's astragalus."

The importance of distinguishing between fractures and fracture-dislocations, and of watching carefully for displacements of the subtalar joint, is emphasized. The important complications—infection, avascular necrosis, and traumatic arthritis of the ankle or subtalar joint—are discussed. Infection may be the result of a compound injury or may follow sloughing of the skin stretched over a displaced talus. Early reduction is, therefore, of great urgency in closed injuries. Avascular necrosis of the talus occurs in gross injuries when all or most of the soft-tissue attachments to the bone are severed. Revascularization and regeneration will take place with patient conservative treatment.

The results of excision of the talus are poor. Every effort should be made to preserve the body of the bone, but if its loss is inevitable a useful foot can be regained by deliberate fusion of the tibia to the calcaneum.

Thirty-nine roentgenograms; 1 drawing; 4 tables.

ABRAHAM J. NICHOLAS, M.D.
Shreveport, La.

Osteoarthropathy in Dogs. Hugo Stunzi. Arch. Path. **54:** 423–429, November 1952.

Four cases of secondary osteoarthropathy in dogs, ranging in age from four to eleven years, are described. The osteoarthropathy was associated with lung tumors, of which two were bronchogenic carcinoma, one a fibrosarcoma of the pleura with metastases to the lungs, and one an adenocarcinoma of the perianal gland with multiple pulmonary metastases. The histologic changes were classified as slow or rapid in development. In the same animal the bones varied considerably in the degree of involvement, and in the same bone one portion of the cortex frequently showed minimal changes while in another portion considerable subperiosteal bone was deposited. The acute form was characterized by active subperiosteal and endosteal bone deposition and by a gradual transformation of the primary fibrillary bone to lamellar structures, combined with a transformation of the intertrabecular tissue to an active bone marrow. The chronic form showed minimal alterations of the periosteum with amalgamation of the subperiosteal bone formation with the cortex. The cyclical new deposition of bone produced cement lines, varying in number from sector to sector.

In 3 dogs roentgen examination showed involvement of all of the long bones with the exception of the terminal phalanges. In the fourth the changes were slight and localized.

Two roentgenograms; 4 photomicrographs.

GYNECOLOGY AND OBSTETRICS

The Diagnostic Value of Arteriography of the Iliac Artery in Gynaecology and Obstetrics. U. Borell, I. Fernström, K. Lindblom, and A. Westman. Acta radiol. **38:** 247–263, October 1952.

Percutaneous retrograde arteriography of the iliac

artery was carried out in 80 cases of gynecological disease and in 21 pregnant women. In 70 of the series satisfactory delineation of the uterine artery (which arises from the internal iliac immediately above the point of origin of the superior gluteal) was obtained, but with increasing experience the percentage of successes was much higher.

A discussion of the normal anatomy of the uterine artery and its branches is presented, together with representative roentgenograms.

Twelve cases of ovarian tumor were studied, and it was noted that if the growth caused significant displacement of the uterus and parametrial stretching, the course of the uterine artery in the parametrium was almost straight. Specific patterns for the identification of myomas were also observed. In all cases in which the myoma was the size of a man's fist or larger, the uterine artery was widened. In very small myomas there was no widening. Myomas in the lower part of the uterus near the cervix displaced the ascending portion of the artery laterally, with the production of a "hairpin bend." The intramural arteries, before they penetrated the substance of the growth, were often straightened or slightly curved, lacking their normal corkscrew appearance. In a few cases the presence of such vessels made possible the diagnosis of myomas as small as hazelnuts. "Intrinsic arteries" were usually well demonstrated in the larger tumors, presenting a branched appearance which the authors liken to a tree or a bush. In combination with hysterosalpingography, arteriography made possible determination of the thickness of the wall of the corpus uteri.

In the 21 cases of pregnancy not only was increase in the size of the uterine vessels demonstrated but also the placental sinuses were opacified from the third month onward.

Twenty-three roentgenograms; 1 drawing.

JAMES E. LOFSTROM, M.D.
Detroit, Mich.

Gartner's Ducts (Their Frequency and Clinical Significance). G. Bianchi, H. Appli, and St. Wilk. Radiol. clin. **21**: 359–362, November 1952. (In German)

In reviewing 66 salpingograms obtained over a period of seventeen years at the University of Bern, the authors observed in 11 cases a linear shadow of contrast medium parallel to the uterine wall. They were unable to find any mention of such a shadow in standard textbooks of gynecology or roentgenology. It is attributed to the presence of Gartner's duct, a persistent remnant of the wolffian duct (mesonephric duct in the female). According to Sakuraoka (Mitt. ü. allg. Path. u. path. Anat. **9**: 179, 1937) this anomaly is present in some 15 per cent of Japanese women.

Gartner's duct is at first intraligamentary and then presses forward in the uterine musculature to the vagina. Remnants are usually found in the lateral uterine wall, often with lateral branches at the level of the cervix, sometimes with cystic dilatation. The authors assume that in their cases there was a connection between these branches and the cervical canal, thereby causing the contrast filling. The duct originated at the junction of the cervix and cavum uteri, running parallel to the contour of the uterus. It was 1 mm. to 3 mm. wide, and disappeared usually in the region of the cornua uteri within the contrast shadow of the uterine cavity.

This anomaly was always unilateral, being seen 4 times on the right side and 7 times on the left. In 9 cases there was an accompanying salpingitis, and all the patients had undergone examination in order to determine the cause of sterility.

In the opinion of the authors, this developmental anomaly predisposes to salpingitis. As they found a uterus arcuatus and several hypoplastic uteri among their cases, they recommend looking for associated malformations in the presence of Gartner's duct.

Two roentgenograms.

HERBERT POLLACK, M.D.
Chicago, Ill.

An Ovarian Cyst Producing the Appearance of a Carcinoma of the Colon. J. B. Herman. South African M. J. **26**: 946–947, Nov. 29, 1952.

The author presents a case of a serous cystadenoma of the left ovary with extensive adhesions to the rectosigmoid colon. Operation revealed torsion of the cystic tumor, hemorrhage, and evidence of infection in the cyst.

A preoperative barium enema study had demonstrated polypoid changes in the rectosigmoid, and a diagnosis of carcinoma was made. A repetition of the examination a week later failed to confirm the earlier observations, the entire colon appearing normal.

The author suggests that the initial appearance of the rectosigmoid may be explained on the basis of a filling defect due to feces, inflammatory changes involving the cyst and the bowel wall, or both.

One roentgenogram.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

THE GENITOURINARY SYSTEM

The Mechanism of the Excretion of Renal Contrast Substances. Bertil Josephson. Acta radiol. **38**: 299–306, October 1952.

The principles of renal excretion are reviewed, with emphasis on the glomerulus-filtration mechanism and tubular excretion as it relates to certain substances, including contrast media. Umbradil in varying dosages was employed in a large series of rabbits followed by critical measurements of plasma concentration and the relationship to glomerulus-filtrate at the end of ten minutes. Additional measurements of the tubular excretion were made.

The plasma concentration of the medium was found to be in direct proportion to the amount injected. Increasing concentrations of injected material were shown to exceed the depression limit of the tubules, with a resultant relative lowering of tubular excretion. For this reason, while large doses are followed by a large total excretion, the excretion following small doses is proportionately much higher. (This does not hold for patients with severely damaged renal parenchyma, since in these cases the tubular epithelium is generally so affected that its excretory capacity is low and often negligible even with low plasma concentration.) Diuresis was shown to have no effect upon the total amount of medium excreted, although there was wide variation in its dilution.

In the clinical experience of the author a reduced dosage of Diodrast is usually given to patients having impaired renal function. He considers the serum creatinine a reliable indication in this respect. If it exceeds 1.4–1.5, caution should be exercised.

An incidental inclusion of a microroentgen photograph of the kidney of a rabbit provides an excellent demonstration of the fixation of the contrast medium in the walls of the tubuli at a ten-minute interval. One schematic drawing and several graphs are also included.

JAMES E. LOFSTROM, M.D.
Detroit, Mich.

Subcutaneous Pyelography in Infants with the Aid of Hyaluronidase and Tomography. J. Brockhaus. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 602–605, November 1952. (In German)

In infants, the subcutaneous administration of a contrast agent with added hyaluronidase may result in adequate pyelograms. Good films may be obtained twenty to seventy minutes after injection. Toxic effects have not been observed.

If tympanites interferes with the interpretation, tomography may furnish diagnostic pyelograms forty minutes after injection. To get the calyces and the ureters in one plane, parallel to the table, the infant must be so positioned that the neck is 7 cm. above the pelvic level.

Three tomograms.

LEWIS L. HAAS, M.D.
Chicago, Ill.

Urographic Changes in Diabetes Insipidus. Report of a Case. R. C. H. Chung and L. K. Mantell. J.A.M.A. **150:** 1307–1308, Nov. 29, 1952.

The authors report a case of hereditary diabetes insipidus uncomplicated by hypertension, with emphasis upon the urographic changes which accompany this malady. The average twenty-four-hour urinary output in their case was 15 liters, with specific gravity ranging between 1.000 and 1.005. Treatment with posterior pituitary extract failed to produce any change in volume of the urinary output. Excretory urograms revealed symmetrical dilatation of the renal collecting systems and ureters. Cystograms with 1,000 c.c. of contrast material showed the dome of the bladder at the level of the iliac crest. The margins were irregular. Endoscopy disclosed coarse trabeculations, and cystometrography an atonic bladder. The authors believe that the above findings can be explained on the basis of a functional incompetence of the outflow capacity of the urinary tract relative to the high urinary volume produced.

It is noteworthy that the patient was inducted and served in the Philippines during World War II, despite his high fluid intake and output.

Three roentgenograms.

ROBERT RAPP, M.D.
University of Michigan

Ectopic Ureter. Report of a Case. Hans Eckerbom and Bengt Liliequist. Acta radiol. **38:** 420–427, November 1952.

The authors report the case of a 45-year-old woman who had had urinary incontinence since childhood. Her complaints were lower abdominal pain, radiating to the back, and fever. The urine showed no sign of infection. Excretory urography revealed double renal pelves and ureters on the left side, passing separately downward to the level of the 4th lumbar vertebra. On the right side, a rather small renal pelvis was observed. Cystoscopy showed a fine fistulous opening in the midline of the anterior vaginal wall just posterior to the urethral orifice. Injection of contrast medium through a cannula introduced into the fistulous passage revealed a wide ectopic ureter on the right, extending up to a rounded, slightly dilated renal pelvis corresponding to the upper half of the kidney. To determine the vascular supply of the right kidney and to demonstrate the demarcation between normal and pathological renal parenchyma, lumbar aortography was done. The contrast medium outlined a large left kidney and a rather small right kidney. The upper pole of the right was poorly filled with contrast medium and "sat like a little hood" on the rest of the kidney, which appeared normal. A small artery supplying the affected part of the kidney arose almost at a right angle from one of the larger renal arteries.

At surgery the extra ureter was found to be thickened and to originate from the upper pole of the kidney, which felt firmer than the rest of the organ. The small vessel supplying the upper part was ligated and that part of the kidney extirpated. On histologic examination the removed portion of kidney alternately exhibited a well preserved and an exceedingly shrunken or rudimentary parenchyma with numerous small cysts.

This case of duplicate ureter is believed to be the first reported in which abdominal aortography provided information valuable in the planning and performance of operation.

The embryology, pathology, incidence, and symptomatology of ureteral ectopia are discussed.

Four roentgenograms; 1 drawing.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Roentgenologic Demonstration During Micturition of Pathologic Changes in the Female Urethra. Björn E. W. Nordenström. Acta radiol. **38:** 264–272, October 1952.

Fifteen case reports are presented, with roentgenograms made during micturition to demonstrate pathological changes in the female urethra. The technic used has been previously described, as have the normal findings (Acta radiol. **37:** 503, 1952, and **38:** 125, 1952. Abst. in Radiology **60:** 624, 1953, and **61:** 143, 1953).

Abnormalities in angulation, funneling of the posterior urethra, strictures, and paraurethral diverticula were demonstrated. Most of the patients experience stress incontinence, and in a few instances both preoperative findings and postoperative results are illustrated.

The main advantage claimed by the author for his procedure is the determination of the physiologic functional state of the urethra, the bladder, and the vesical neck as opposed to the static pattern obtained in retrograde urethrocystograms made with the usual technic.

Twenty-four roentgenograms; 1 drawing.

JAMES E. LOFSTROM, M.D.
Detroit, Mich.

TECHNIC; CONTRAST MEDIA

A Simple Technique for Simultaneous Screening and Radiography. Ove Mattsson. Acta radiol. **38:** 361–366, November 1952.

It is often desirable to be able to study the screen image of a patient up to the very instant of the radiographic exposure. This is especially true in observing the swallowing process. Films taken when there is maximum filling of the hypopharynx and upper esopha-

gus by contrast medium may reveal the valve-like filling defects connected with Plummer-Vinson's syndrome.

The author describes a technic for simultaneous screening and radiography. A mobile dental unit equipped with a separate milliampere control for screening is used as the screening tube. This is set so that the central rays form an angle of 90 degrees with those of the exposure tube, the latter the under-table tube of a fluoroscopic unit. A fluoroscopic screen is positioned opposite the dental tube. A loaded cassette is placed in position behind a grid, which reduces the effect of secondary radiation on the film during the screening period. The controls are conveniently placed so that instantaneous exposure can be made at the desired moment as determined by screen examination. The postero-anterior view is observed on the screen while the lateral is projected onto the film, and *vice versa*.

Five roentgenograms show maximal contrast filling of the upper esophagus. One drawing and 2 photographs show the arrangement of equipment for simultaneous screening and radiography.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Notes on the Technique in Phlebography of the Thigh. Per Ödman. Acta radiol. **38:** 367–374, November 1952.

For phlebography of the thigh, the author punctures the vein percutaneously with a needle approximately 12 cm. in length. Through this a fine polyethylene catheter about twice the needle length is introduced. This catheter is threaded on a "leader," a somewhat shorter straight steel wire. This permits some direction of the catheter. The leader and needle are then removed, leaving the catheter in the vein.

For retrograde phlebography, the common femoral vein is punctured at the level of the groin. Twenty cubic centimeters of 50 per cent Umbradil is injected while two films are exposed with the leg rotated as desired. These views include the pelvis and the thigh. Reinjection is then done, and lateral and anteroposterior roentgenograms are taken of the thigh and lower leg. A third injection is made, and the series is completed with further films of leg, thigh, and pelvis. The object is to determine to what extent the contrast medium passes in a retrograde direction when insufficiency of the femoral and popliteal veins is suspected. For the actual phlebography the patient stands, leaning backward against the table tilted at 60 degrees to the horizontal.

Phlebography after injection of a dorsal pedal vein may be supplemented by injection of contrast medium into the popliteal vein. The vein is punctured by the technic described above. The needle is introduced into the back of the leg and directed obliquely upward and medially. With the patient standing at 60 degrees, the contrast medium is injected slowly and films of the pelvis and entire leg in different projections are obtained.

The procedure described offers several advantages, among which are better protection for the operator against radiation and improved facilities for examining the patient in various positions.

Ten roentgenograms; 2 drawings.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Pulmonary Reaction to Barium Sulfate in Rats. John Huston, Jr., D. P. Wallach, and George J. Cunningham. Arch. Path. **54:** 430–438, November 1952.

During the examination of the pharynx and esophagus of a patient by means of a barium swallow, it was noted on fluoroscopy and on the subsequent roentgenograms that small amounts of the medium had entered the lungs. While it was considered that this exerted no ill effects on the lungs, it seemed worth while to determine the histologic reaction of rat lung following the introduction of a barium sulfate suspension. Eighteen animals were used in the investigation. The material was instilled directly into the lungs by tracheal intubation in order to avoid any surgical procedure that might complicate the ultimate findings. Roentgenograms were taken immediately prior to and after injection. Further films were taken of the animals before killing and of the lungs after removal from the body. Two rats died within 2 hours of the injection. The remainder were killed at varying intervals—at 30 minutes, 2, 12, 24, 48, and 72 hours and 7, 15, 30, 94, and 126 days.

On the basis of their observations, the authors conclude that barium sulfate is a relatively inert substance in the tissues and gives rise to only a very mild reaction. At first the suspension is taken up by polymorphonuclear leukocytes, which subsequently degenerate and liberate the suspension, which is then taken up by mononuclear cells. It is likely that toxic action of the salts accounts for the degeneration of the polymorphonuclears as well as for the similar change which overtakes the mononuclears at a later date. When the barium is liberated from these cells, it becomes inspissated into refractile masses (the authors have no explanation as to why this occurs). The toxic effects of the barium salt may also be seen in the respiratory epithelium, which probably undergoes degeneration and subsequently regenerates. The amount of tissue reaction is slight, and giant-cell reaction of the foreign body type commences after about 90 days. Finally, although barium sulfate if present in quantity cannot be completely removed, it is likely to give rise to little fibrosis ultimately.

Six roentgenograms; 6 photomicrographs.

RADIOTHERAPY

Malignant Disease in the Transvaal. I. Cancer of the Skin. First Statistical Report from the Radiation Therapy Department of the Johannesburg Group of Hospitals. Lionel Cohen, M. P. Shapiro, P. Keen, and A. J. H. Henning. South African M. J. **26:** 932–939, Nov. 22, 1952.

A statistical study was made of the pooled figures for cases of neoplasm of the skin from the various hospitals in the Southern Transvaal, referred for radiation therapy. Of the 578 cases of skin cancer, 548 were in white-skinned persons (8 of them albino Bantu Negroes). Not a single case of typical rodent ulcer was found in a normal dark-skinned Bantu. Nine of the malignant tumors in the Bantus were melanomas;

6 of the 11 squamous-cell cancers were complications of pre-existing lesions (burns, keloid, syphilis, tropical ulcer). Thus a firm statistical foundation is provided for the statement that solar radiation stimulates the formation of skin cancer in susceptible persons. (The pigmentation in the normal Bantu skin provides almost complete protection in contrast to the Europeans and the albinos.) Further proof is provided by the location of the lesions: in the Europeans, 98 per cent were on exposed skin, while in the Bantus only 2 epithelial lesions were found on the head or neck.

The obvious lesson is prevention by proper protection where ultraviolet radiation is intense.

Nine photographs; 2 graphs; 6 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Lupus Carcinoma; with Special Reference to the Applicability of Radiotherapy. Povl Hjorth. Acta radiol. **38:** 323–337, October 1952.

The complication of carcinoma has been observed in cases of lupus vulgaris treated by ultraviolet light, roentgen rays, or radium, as well as in the untreated state. The author has studied 27 such lesions in 25 patients. Since in most of these the lupus had been treated by Finsen light, roentgen irradiation can be accorded only a minor etiologic role in this series. The sex distribution of the cancers was almost equal. The average age at the time the cancer was diagnosed was sixty years, with a range of thirty-seven to eighty-eight. The lesions all developed in areas which are habitually exposed to light. There was no instance of the neoplasm originating in the mucous membranes, although there was mucosal involvement by lupus in 17 of the 25 patients.

Twenty-five of the carcinomas in this series received radiotherapy. Radium was utilized in 6 small carcinomata and roentgen therapy in the remaining 19 cases. No radionecrosis developed in any of the cases. Of 15 patients treated by roentgen therapy and adequately followed, 6 remained symptom-free at least five years. The 6 patients treated by radium were all symptom-free for five years, although in one a recurrence developed at seven years. Unfavorable circumstances producing a poor prognosis were: (1) extension of the process over a surface exceeding 3 × 4 cm., (2) invasion of bone or cartilage, (3) an infiltrating growth, (4) metastatic involvement of the regional lymph nodes, (5) florid lupus vulgaris of the cicatrix.

Six photographs; 3 tables.

JAMES E. LOFSTROM, M.D.
Detroit, Mich.

Comparative Study of Various Radiation Methods as Adjuncts to Surgery in Carcinoma of the Corpus Uteri. T. Leucutia. Am. J. Roentgenol. **68:** 770–778, November 1952.

Leucutia has reviewed 240 cases of carcinoma of the corpus uteri treated from 1924 to 1945 at Harper Hospital, Detroit, by means of intracavitary radium, external roentgen therapy, and hysterectomy in various combinations. In his end-results only the patients known to be alive at the end of the period studied are considered as survivors. Thus, he counts as failures any cases lost in follow-up or with death due to causes apparently unrelated to the neoplasm.

Treatment methods underwent two major changes after the series started, with consequent improvement in the five-year cure rate. At present, in operable cases roentgen therapy is given with 500 kv., h.v.l. 9 mm. Cu, with a dose of 2,500 r delivered to the uterus in eight to ten days. This is combined with intra-uterine radium, usually 50 mg. for ninety-six hours, giving a dosage of 33,000 gamma roentgens to the endometrium, 4,850 to the outer wall of the uterus, and 1,500 r to the distant parametria. Hysterectomy is done six to eight weeks later and a second course of roentgen therapy is given two or three weeks after the operation.

In inoperable cases two radium applications are made, at an interval of eight to ten weeks, each combined with supervoltage roentgen therapy. The first radium application is as described above; the second is reduced by 25 per cent.

The five-year survival rates are as follows: For preoperative irradiation, hysterectomy, and postoperative irradiation, 81.2 per cent for 64 cases; for hysterectomy and postoperative irradiation, 47.8 per cent for 71 cases; for irradiation alone in inoperable cases, 42.8 per cent for 105 cases, though for the most recent inoperable group (64 cases) the rate was 48 per cent.

Six tables.

W. L. BRIDGES, M.D.
Indiana University

Effect of Preoperative Radiation of Adenocarcinoma of the Endometrium. Herbert E. Schmitz, Charles J. Smith, and Chester J. Gajewski. Am. J. Obst. & Gynec. **64:** 952–966, November 1952.

A specific technic of irradiating the uterus, parametria, and pelvic lymphatic areas is reported. At diagnostic curettage, a Y radium applicator containing 50 mg. of radium element in each arm and in the stem is inserted into the uterine cavity. The radium is removed when 2,000 mg. hr. have been delivered and is twice reinserted at eight-day intervals for a total dose of 6,300 mg. hr. The parametrial tissues and pelvic lymph nodes receive roentgen irradiation through multiple ports.

Studies have been made of the entire endometrium and endocervix with the adjacent tissues following operation. Radionecrotic plaques, endometrial, myometrial, and blood vessel changes are described. The authors are especially interested in the group subjected to genital extirpation after irradiation. Since they have used a standardized preoperative radiation dose in the range of 6,000 mg. hr. of radium, and 4,000 to 6,000 r of 800-kv. x-rays to the mid pelvis, 75.67 per cent of cases have shown no evidence of viable tumor in the surgical specimen, irrespective of clinical grouping. Prior to the use of this standardized technic, the figure was 57.69 per cent.

The extent of the disease according to the clinical grouping of Schmitz is a gravely influencing factor in survival. Histologic grading bore no definite correlation to clinical extent of disease or survival.

Fifteen figures.

MASON WHITMORE, M.D.
Jefferson Medical College

Results of Treatment of Cancer of the Cervix. J. B. Blaikley, Manuel Lederman, and T. L. T. Lewis. Lancet **2:** 950–951, Nov. 15, 1952.

The authors present 10 tables, giving the results obtained in cancer of the cervix by Wertheim's hysterectomy, by radiotherapy, and other procedures, at the Chelsea Hospital for Women and the Royal Cancer

Hospital, London. Since the entire value of the paper lies in the tables, it must be consulted in the original.

The Cause of Death in Patients Treated for Cervical Cancer. Daniel G. Morton and William Dignam. Am. J. Obst. & Gynec. **64**: 999–1005, November 1952.

The authors analyze the results in a group of 713 patients with cancer of the uterine cervix: 631 treated by irradiation and 82 by radical hysterectomy. In most cases treatment was by a combination of radium and x-rays. Pelvic lymphadenectomy was done in addition to irradiation in 36 cases. Radical hysterectomy was reserved for Stage I and "early" Stage II cases. At the time of the report, 492 patients had died, 83 from causes other than cervical cancer and 409 because of the cervical cancer. The causes of death are given as (1) local persistence of the cancer, (2) regional or distant metastases, (3) a combination of (1) and (2), (4) complications of treatment, (5) natural causes other than cancer, (6) other cancer. There were 30 deaths of patients with Stage I carcinoma, apparently as a result of persistence of the local disease, 9 of them within the first year. In the group where deaths were due to metastasis, the number of five-year survivals was greater than in the group succumbing to local disease.

In this series, the patient who could be treated operatively appeared to have a better chance (8:5) of five-year survival than those who were treated radiologically.

Five of 18 patients with lymph node involvement survived for more than five years; 2 were still alive at the time of the report.

One graph; 7 tables. MASON WHITMORE, M.D.
Jefferson Medical College

Injuries to the Terminal Bowel Due to Pelvic Malignancy and Its Treatment. Herbert E. Schmitz and Janet E. Towne. Am. J. Surg. **84**: 558–565, November 1952.

Because of its close proximity to the genital tract, the distal bowel may be invaded by pelvic neoplasms or injured by the means used to eradicate them, whether it be irradiation, surgery, or a combination of the two.

Although the amounts of x-ray and radium radiation required to destroy the average squamous-cell carcinoma exceed the tolerance of the bladder and bowel mucosa, modern technics make the high dosage possible through filtration, protection of the bladder and bowel by packing, and cross-fire. Such therapy is successful in a high percentage of Group I and Group II cervical or uterine lesions.

In the advanced stages of the disease, Groups III and IV, either the bowel is invaded by disease too early for clinical detection or the malignant cells are so near that injury to the bowel must be accepted if the patient is to be saved. Pelvic exenteration, as advocated by Brunschwig, proposes removal of all involved structures; so also irradiation should be used to its fullest if success in destroying the disease is expected.

In spite of all precautions, including multiple ports of external irradiation to cross-fire the lesion but by-pass the bowel, 100 per cent of the patients treated have varying degrees of proctosigmoiditis. This is evidenced by diarrhea, cramping, tenesmus, and at times bleeding from the bowel. On examination, one finds the mucous membrane to be diffusely hyperemic, with edema, small petechial areas which bleed readily if traumatized, and increased mucous secretion. Most pathologic changes subside without permanent damage; others may be progressive. Late changes include ulcers or eschar, rectovaginal fistula, and cicatricial deformities leading to partial or complete obstruction. The more serious complications occur in the heavily irradiated resistant or recurrent tumors of Groups III and IV and are justified by the number of patients in these groups surviving five years.

The authors present abstracts of 4 case histories of carcinoma of the body and cervix of the uterus. Each illustrates a complication of the treatment and its management.

One roentgenogram; 12 photographs and photomicrographs. FRANK T. MORAN, M.D.
Auburn, N. Y.

The Reticuloses and Lymphoreticular Sarcomas from the Radiotherapist's Point of View. Margaret C. Tod. Edinburgh M. J. **59**: 457–477, October 1952.

Reticulosis is a name applied to certain forms of neoplasia which appear to be multifocal in origin and have characteristic symptoms of systemic disturbance. When the true sarcomas of lymphoid tissue are included, whether they be differentiated or anaplastic, the term lymphoreticular neoplasia is more accurate. For purposes of this discussion, the following pathological reports have been regarded as indicating the presence of a reticulosis or lymphoreticular neoplasm: Hodgkin's disease or lymphadenoma, Brill-Symmer's disease or lymphoid follicular reticulosis, leukemia, lymphosarcoma, reticulum-cell sarcoma, anaplastic sarcoma, and cases with such doubtful reports as "anaplastic tumor, may be either sarcoma or carcinoma."

The material analyzed came from Christie Hospital, Manchester, England. It includes 777 cases treated in the years 1940–47, all of which were proved by pathological examination. The cases are grouped as follows:

	Cases
Hodgkin's disease	275
Brill-Symmer's diseases	24
Lymphosarcoma	108
Reticulum-cell sarcoma	57
Anaplastic tumors (may be either sarcoma or carcinoma)	156
The leukemias	157

In the analyses of the material, the blood diseases are disregarded and attention is focused upon the true reticuloses (Hodgkin's and Brill-Symmer's diseases) and the lymphoreticular sarcomas and anaplastic tumors, which may be either sarcomas or tumors derived from primitive epithelial tissue. The distribution of these two groups according to age, sex, and duration of symptoms, the sites involved, and the complications are presented in a series of tables. Hodgkin's disease and Brill-Symmer's disease affect the lymph nodes primarily and involve other tissues and organs in the late stages. Their systemic manifestations play an important role in prognosis. The tumors, on the other hand, arise in, or in association with, lymphoreticular tissue, infiltrating locally and producing secondary deposits in the lymph nodes and distant metastases.

Localized tumors with pathological reports suggesting that they may be lymphoreticular sarcoma are treated by x-ray therapy to full dosage. In certain selected

cases of early Hodgkin's disease and Brill-Symmer's disease, similar treatment may be used. The treatment of generalized lymphoreticular tumors, true reticuloses, and sarcoma should be in the first place by palliative x-ray therapy, which should aim at conserving the general tolerance of the patient.

Crude survival rates are presented showing the percentage of patients alive after three and five years. These are as follows:

Generalized Hodgkin's disease (109 cases)
25 alive 3 years (23 per cent)
12 alive 5 years (11 per cent)
2 well 5 years (2 per cent)
Generalized lymphoreticular sarcomas and anaplastic tumors (77 cases)
14 alive 3 years (18 per cent)
5 alive 5 years (6 per cent)
3 well 5 years (4 per cent)

Of all patients with Hodgkin's disease (275), 31 per cent lived three years and of 151 available for five-year results 21 per cent were alive at the end of that time. The corresponding figures for all cases of lymphoreticular sarcomas and anaplastic tumors were 40 per cent of 321 cases and 36 per cent of 192 cases.

Eight of 24 patients with Brill-Symmer's disease were alive at three years, but only 1 was well. No five-year results were available. Of 157 patients with leukemia, 21 per cent were alive at three years.

One roentgenogram; 7 photomicrographs; 10 photographs; 1 graph; 16 tables.

Treatment of Conduction Deafness with Roentgen Therapy. J. Donald Sjoding. Minnesota Med. **35:** 1042–1046, November 1952.

This paper describes the treatment of conduction deafness with roentgen therapy in the Mankato Clinic in Minnesota. The author discusses the pros and cons of radium and roentgen rays in this condition. The conclusions which he has reached, with the use of various definite specific examples, apparently prove his case in favor of the roentgen ray. The cases treated are those in which there is a definite secondary auditory tube obstruction from lymphoid hyperplasia. The disadvantages or objections which have been raised to the use of roentgen therapy are briefly disposed of, and it is stated that no permanent harmful effects of the treatment have been seen.

The method of treatment is given in some detail and stress is laid throughout on the application of therapy by a certified roentgenologist. Of the 109 patients receiving roentgen therapy to the nasopharynx, since March 1949, 32 returned for follow-up study. Of these, 18 (56.25 per cent) regained normal hearing, 6 (18.75 per cent) showed marked improvement in hearing, 3 (9.37 per cent) were slightly improved, and 5 (15.62 per cent) experienced no change in hearing after roentgen therapy.

The author stresses the fact that the otolaryngologist and the roentgenologist must work together in this form of therapy. There are no roentgenograms or photographs included in his discussion. Reports are all based on physical examination and clinical observations.

Six case reports are presented.

A. WILSON BROWN, M.D.
Shreveport, La.

Contribution to Roentgen Diagnosis and Therapy of Actinomycosis of the Lung. H. J. Gombert. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 578–581, November 1952. (In German)

A case is reported in which a chest film showed bilateral inflammatory lesions. Sputum examination revealed *Actinomyces*. Penicillin and sulfa drugs were without effect. After roentgen therapy, however, the pulmonary changes rapidly regressed. The author believes that the preliminary bacteriostatic medication contributed to the favorable radiation effect by elimination of mixed infection.

Three roentgenograms. LEWIS L. HAAS, M.D.
Chicago, Ill.

Some Observations on Roentgen Therapy of Bursitis and Peritendinitis Calcarea of the Shoulder. Robert L. Garber. Ohio State M. J. **48:** 918–919, October 1952.

The author considers irradiation the treatment of choice for "painful shoulder" when a diagnosis of acute or chronic bursitis, with or without calcification, can be made. Roentgen therapy acts to induce an active circulation for the local passive congestion, with concomitant relief of pain and swelling, as well as favoring absorption of calcium deposits.

A rather wide variety of technics have been employed by various therapists. The author uses 200 kv., 0.5 mm. Cu plus 1.0 mm. Al filtration, 50 cm. T.S.D., and a 10 × 10-cm. cone. The irradiation is directed to the anterolateral aspect of the shoulder, with the patient seated and supporting the arm in a flexion position: 150 r (in air) three times a week for acute bursitis and 150 r (in air) three times a week for two weeks in subacute and chronic bursitis and in peritendinitis calcarea.

Of the author's series of 111 cases, 64 (57.6 per cent) showed calcification in the region of the bursa or of the supraspinatus tendinous insertions of the shoulder on pretreatment roentgenograms. Only 10 per cent of the patients gave a history of trauma. Good results were obtained in 92.8 per cent of the entire series. Patients with acute bursitis and negative roentgenograms almost invariably responded to three or less treatments; patients with acute bursitis and calcification required at least six treatments.

Three tables. GEORGE A. SHIPMAN, M.D.
New Orleans, La.

The Empiric Usage of Low-Dosage Irradiation in Amenorrhea. S. Leon Israel. Am. J. Obst. & Gynec. **64:** 971–983, November 1952.

While the mechanism by which x-rays influence pituitary and ovarian function is unknown, the favorable effects of irradiation in selected cases of dysfunctional menstrual disorders are indisputable.

The present report concerns 124 cases of secondary amenorrhea treated by low-dosage irradiation on an empiric basis. Previous unilateral oophorectomy, immature ovaries, and possible early pregnancy were regarded as contraindications to the treatment. Both the pituitary and ovaries were irradiated at each of three sittings, one week apart, the pituitary through a lateral portal 3 × 3 cm., and the ovaries through a single anterior 15 × 15-cm. portal. Factors were 140 kv., 50 cm. skin distance, filtration 0.25 mm. copper plus 1.0 mm. aluminum. A dose of 80 to 100 r (in air) was given to each field per week. The total doses to

the pituitary and ovaries were approximately equal, totaling about 105 r.

The greater the interval between menstrual periods, the less was the response to therapy. Twenty-seven patients became pregnant, 24 within six months of treatment. One abnormally formed child (microcephalic) was born, but it appears that conception in this instance occurred prior to the second and third treatments.

Seven tables.

MASON WHITMORE, M.D.
Jefferson Medical College

Fifteen-Year Sterility Due to Pituitary Adenoma Relieved by X-Ray Therapy. Ira I. Kaplan. Am. J. Obst. & Gynec. **64:** 1175–1176, November 1952.

A 34-year-old white married woman suffered visual disturbances found to be due to a pituitary tumor. Following x-ray therapy (2,500 r measured in air to the central and 2,000 r to right and left temporal areas) vision was restored. At the age of thirty-eight menstruation, which had ceased suddenly at twenty-five years, after a normal onset and regular cycle, again occurred, continuing normal and regular until the patient became pregnant. At the age of forty, she gave birth to a normal baby girl.

W. A. NAFIS, M.D.
Jefferson Medical College

A Clinical Evaluation of the Use of Radium Therapy in the Control of Benign Uterine Bleeding. John B. Montgomery, Joseph P. Long, and Jacob Hoffman. Am. J. Obst. & Gynec. **64:** 1011–1019, November 1952.

Clinical evaluation of 1,232 patients treated with radium for benign uterine bleeding is made. One hundred and seventy-six had symptoms referable to pelvic floor relaxations which were corrected by plastic procedures at the time of radium application. Pelvic examination under anesthesia, diagnostic curettage, and cervical biopsy, when appropriate, were regularly carried out.

The indication for radium therapy was abnormal bleeding in menopausal women in whom expectant treatment had failed and no extrauterine lesion was found. In patients with myoma, radium was restricted to intramural tumors with a mobile uterine fundus not larger than three months gestation. Contraindications included fever, leukocytosis, rapid sedimentation rate, pelvic pain or pressure, adnexal disease, pedunculated, submucous, soft or tender myomas, and fear of radium on the part of the patient.

Prior to 1937, irradiation was administered by means of two 50-mg. capsules of radium sulfate enclosed in glass, one screened with 0.3 mm. of silver and 1.0 mm. of brass, and the other by 0.5 mm. of platinum. After 1937, the capsules were screened with 1.5 mm. of platinum. During the last two years of the study multiple sources of 5.0 mg. each, screened with 0.5 mm. of platinum, were used in patients whose bleeding history was suggestive of endometrial cancer, the ultimate dose depending upon the report of the pathologist on curettings.

For appraising the results, the cases are divided into two groups: dysfunctional bleeding and myomas. In the dysfunctional group the results were satisfactory in 93.1 per cent of the cases, the outcome being less satisfactory in the younger patients. Most patients received 1,000 mg. hr. of radium or less; 600 mg. hr. proved adequate in older women with small uteri. Most of the failures were in younger women treated with low dosage. Thirty of the 36 failures in the dysfunctional group occurred during the first five years of follow-up, and 15 of these during the first two years. The 6 failures in the 257 patients followed from five to twenty years were due to cancer.

In the myoma group, 325 or 71.1 per cent of the 456 patients were followed for six months to twenty-one years. Results were satisfactory in 284, or 87.5 per cent, and unsatisfactory in 41, or 12.6 per cent. The larger number of failures occurred within three years of the initial treatment. Four of the 41 failures in this group were due to subsequent cancer.

Histologic studies of the endometrium in the entire group treated showed that abnormal uterine bleeding may occur from endometrium of any type. No one type predominated among the patients whose initial treatment was unsatisfactory. In patients in whom endometrial cancer eventually developed, the original endometrium revealed atrophic changes in 3, mild cystic hyperplasia in 3, proliferative phase in 1, and secretory phase in 1. Pelvic cancer developed subsequently in 12 of 851 patients followed, an incidence for the entire series of 1.4 per cent. In the dysfunctional group, 5 cancers of the corpus developed six, eight, eleven, twelve, and fifteen years after the initial irradiation. Irradiation dosage in these cases was 800, 1,200, 1,200, 1,800, and 700 mg. hr., respectively. One advanced cancer of the ovary occurred eight years after the original treatment in a patient who did not return for the follow-up examination. In 6 of 325 patients in the myoma group cancer subsequently developed, in 4 in the corpus and in 2 in the cervix. One found unexpectedly one year after initial treatment was high in the endometrial cavity, probably inaccessible to the curette originally. The other corpus cancers occurred four, ten, and eleven years after the radium treatment.

The authors conclude that expression of satisfaction by 90 per cent of patients followed is impressive, and more radical treatment would not have been justified in these women. If the number of failures can be further reduced by restricted indications, irradiation with radium may continue to be an acceptable method of treatment for benign uterine hemorrhage. Fear of cancer by the patient and physician has become an important factor in restricting the use of irradiation and increasing hysterectomy. Condemnation of the method has occurred following the discovery of cancer in some patients subsequent to irradiation for benign conditions, often because of errors in diagnosis and judgment. The incidence of subsequent cancer in the series presented is 1.4 per cent. The frequency of surgical errors in the diagnosis and management of uterine cancer, especially of the corpus, would substantially exceed this figure, as has been brought out by the work of the Committee for the Study of the Delay Period in Pelvic Cancer carried out in Philadelphia during the past six years. If radium irradiation is to be satisfactory, accuracy of diagnosis is paramount. In most instances emotionally unstable women are poor subjects for irradiation therapy. Adequate irradiation dosage and adequate follow-up examinations are important in achieving full success of irradiation therapy in treatment of benign uterine bleeding.

Twelve tables.

W. A. NAFIS, M.D.
Jefferson Medical College

A Technique for Intracavitary Radiation of the Bladder. D. M. T. Cones and C. Gregory. Brit. J. Radiol. **25**: 597–600, November 1952.

A method of delivering a uniform dosage to the mucosa of the bladder by means of a distended balloon in the center of which is a radioactive cobalt source is described. Surface and depth doses are given. No clinical applications are recorded.

Four figures, including 2 roentgenograms.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

A Direct Current Amplifier Recording System for Precise Measurement of Depth Dose. H. E. Johns, E. R. Epp, and S. O. Fedoruk. Am. J. Roentgenol. **68**: 788–796, November 1952.

This paper discusses the details of a method to determine rapidly and accurately the percentage depth dose from a roentgen unit in relation to the dose on the surface. Diagrams and technical details of the experimental arrangement are discussed in the paper. Traces are simultaneously obtained from a monitor ionization chamber in the x-ray beam and an ionization chamber in the phantom which can be mechanically raised or lowered in depth. From these traces the depth doses can be determined.

The details of the apparatus used are well described in the article. By means of pen-recording systems, and a D.C. amplifier with its associated probe, depth dose may be measured to an accuracy of 0.5 per cent.

Seven illustrations.

HAROLD R. GRIFFITH, M. D.
Indiana University

Visual Aid in Teaching Radiation Therapy. Oscar H. Cohen and Rieva Rosh. J.A.M.A. **150**: 1306, Nov. 29, 1952.

The authors advocate the use of a special type of translucent anatomic model of the head and neck in association with a special beam of light in order to emphasize the importance of proper placement and aiming of the beam of radiation. This is of prime importance for training in beam direction especially for areas commonly treated with radiation; namely, the pituitary, nasopharynx, tongue, and larynx.

Four photographs.

ROBERT RAPP, M.D.
University of Michigan

RADIOISOTOPES

The Indications for Radio-Iodine Treatment of Thyroid Carcinoma. E. E. Pochin, Gwen Hilton, N. B. Myant, A. J. Honour, and B. D. Corbett. Brit. M. J. **2**: 1115–1121, Nov. 22, 1952.

This paper is far more comprehensive than the title would indicate, covering the many facets of radioiodine treatment of thyroid carcinoma.

The authors state that complete surgical excision remains the treatment of choice for thyroid carcinoma whenever it is possible. Otherwise, radioiodine should be used for any thyroid carcinoma which will take up the isotope sufficiently. The most direct evidence of radioiodine uptake in a tumor is furnished by biopsy material. The authors discuss the determination of radioactivity of tissues thus obtained by autoradiography, by "liquid counting" of tissue extracts, and by use of a gamma-radiation counter. Detection of radioiodine within the body by "local counting" and by "profile counting" is also discussed. Methods of detecting metastases remote from any iodine-concentrating tissues (thyroid, kidneys, urinary bladder, stomach, and salivary glands), adjacent to iodine-concentrating tissues, and close to the thyroid are outlined.

Radioiodine uptake in thyroid carcinoma may become demonstrable only after all normal thyroid tissue has been ablated surgically or with radioiodine. Possible explanations of this are as follows: (1) The amount of isotope uptake by the tumor may be greater when it is competing for radioiodine against the kidneys alone, and not against the kidneys and the normal thyroid. (2) The detection of weak uptake is technically simpler if no site of strong uptake, such as thyroid tissue, is adjacent. This is most important with cervical metastases. (3) In certain cases the capacity of the tumor to concentrate iodine seems to develop or increase after thyroid ablation.

Thyroid ablation is thus a practical necessity for detecting cases which may be suitable for radioiodine treatment.

Radioiodine uptake occurred in between one-quarter and one-third of 27 patients with thyroid carcinoma studied by the authors. Of those with mainly differentiated tumors examined after ablation, uptake was demonstrated with certainty in over one-half and probably in about three-quarters.

The following procedure is suggested for the management of thyroid carcinomata:

1. Biopsy for evidence both of the thyroid origin of the tumor and of its degree of differentiation.
2. Radical excision if this appears likely to be successful. If this is attempted and found to be impracticable, and if biopsy has revealed a differentiated tumor, as much normal thyroid tissue as possible should be removed at this operation.
3. Inoperable tumors that are undifferentiated and seem likely to be radiosensitive should be treated by radiotherapy if sufficiently localized and unless they have been shown to take up radioiodine.
4. For inoperable but well differentiated tumors and for those with colloid-filled follicles throughout their structure, thyroid ablation should be effected by surgical total thyroidectomy if possible, or by the use of radioiodine in therapeutic dosage. Ablation is unlikely to be justifiable for anaplastic and rapidly growing tumors.
5. After thyroid ablation, radioiodine treatment should be instituted if adequate uptake can be detected in the tumor or induced, for example by use of thiouracil. Therapy is continued, within limits of radiation tolerance, until profile counting after a test dose reveals no abnormal site of radioiodine retention.

Nine illustrations; 2 tables.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

Five Year Experience with Radioactive Iodine in Treatment of Hyperthyroidism. D. E. Clark, J. H. Rule, O. H. Trippel, and D. A. Cofrin. J.A.M.A. **150**: 1269–1272, Nov. 29, 1952.

The authors report their experience with radioactive

iodine in the treatment of primary or secondary hyperthyroidism in a group of 384 patients including 100 previously reported. Their indications for this treatment are listed as: uncomplicated hyperthyroidism in patients over forty years; recurrent or persistent hyperthyroidism after thyroidectomy; hyperthyroidism with severe cardiovascular disease or other concurrent disease; failure to respond properly to antithyroid drugs; refusal of surgical or other therapy; severe exophthalmos. Coexistent pregnancy is considered an absolute contraindication.

Dosage is based on estimated weight of the gland, type of gland, and age of patient. For diffusely enlarged glands the initial dose is 150 or 250 mc. per estimated gram for patients under and over forty years respectively. In those with nodular glands 300 to 350 mc. per estimated gram is used. After the initial dose, the patients are followed at two-month intervals and if this dose is found to be inadequate treatment is repeated until a euthyroid state is reached. One patient received as many as ten separate doses.

The authors found no recurrence in any of the patients who remained in a euthyroid state for a period of four months. Remissions were obtained in 76 per cent of cases with one or two doses. In 13.8 per cent varying degrees of hypothyroidism developed. In only 1 per cent did apparent permanent myxedema occur. Otherwise no complications were observed. Approximately twice as much I^{131} was required to effect a remission in patients with nodular glands as in those with diffuse enlargements.

Pre-existent exophthalmos was not increased in any case by treatment. In 94 patients with exophthalmos, adequately evaluated, 19.1 per cent had complete regression, 58.5 per cent showed improvement, and 18 per cent showed no change in the exophthalmos. In 3 patients without exophthalmos prior to treatment unilateral exophthalmos developed.

One graph; 5 tables.

ROBERT RAPP, M.D.
University of Michigan

The Identification of Atypically Located Thyroid Tissue by Tracer Studies with Radioiodine. S. Läser. Radiol. clin. **21:** 387–391, November 1952. (In German)

The favorable composition of the radiation from radioiodine, emitting beta and gamma rays, enables easy recognition of its uptake in functioning thyroid tissue by means of percutaneous measurements.

Three cases are presented:

The first patient, a 73-year-old female, was admitted to the hospital with the diagnosis of a mediastinal tumor. Tracer studies with radioiodine confirmed the clinical suspicion of a substernal, intrathoracic goiter with compression of the trachea.

The second patient, a 52-year-old female, was hospitalized because of acute hemorrhage from the gastrointestinal tract with severe secondary anemia. During her stay in the hospital she complained of pain and weakness in the right hand and arm. On examination a hard fixed tumor, the size of a small orange, was felt between the cervical spine and the anterior border of the trapezius muscle. No enlargement of the thyroid gland was palpable. Radiographs of the chest showed a calcified, freely movable node in the center of the thyroid and miliary small nodules throughout the lungs (miliary carcinosis). Biopsy of the neck tumor revealed a struma parenchymatosa nodosa with transition into infiltrative Langhans struma. The diagnosis of aberrant goiter with malignant degeneration was made. The neck tumor did not respond to palliative x-ray therapy but regressed to some extent after oral administration of 35 mc. of I^{131}. The radiographic appearance of the chest did not change, but the basal metabolic rate declined from +54 to +22. Two months later a second dose of I^{131}, 50 mc., was administered, followed by improvement of the pulmonary carcinosis. Further administration of radioiodine was under consideration at the time of the report.

The third patient, a 58-year-old female, complained of shortness of breath. Examination revealed a substernal goiter with compression and displacement of the trachea toward the left. Tracer studies with 0.09 mc. of I^{131} showed normal values. At operation the diagnosis of intrathoracic goiter was confirmed. Two intrathoracic thyroid nodules were removed, one of which showed a large area of central necrosis. The author attributes the negative result of the tracer studies to the inability of the necrotic tissue to store radioiodine. He believes, therefore, that negative results should be anticipated in hemorrhagic, softened goitrous nodules and in the majority of malignant goiters, as only about 10 per cent of these lesions are able to store an adequate amount of iodine.

In all tumors of the upper mediastinum where a radiological or clinical diagnosis of a struma cannot be definitely established, tracer studies are recommended.

Two roentgenograms; 4 drawings.

HERBERT POLLACK, M.D.
Chicago, Ill.

The Metabolic Fate of I^{131} After Large Therapeutic Doses in Patients with Metastatic Carcinoma of the Thyroid. John B. Stanbury, Gordon L. Brownell, José Barzelatto, Javier Correa, Jorge Maisterrena, Jaime Cortazar, and Jaime Rodriguez-Soto. J. Clin. Endocrinol. & Metab. **12:** 1480–1494, November 1952.

Large doses of I^{131} (100 to 300 mc.) were given 8 patients having alveolar or mixed papillary and alveolar carcinoma of the thyroid. All but 2 of the patients had had total surgical thyroidectomy. In all cases there was evidence of metastatic disease, with satisfactory localization of I^{131} on preliminary tracer studies.

After initial periods of adjustment, the radiation measured from the body as a whole followed a simple exponential decay with biologic half-periods varying from three to twelve days. The rate of fall was higher than expected and may be explained in several ways: (1) re-utilization of the I^{131} released from breakdown of the protein-bound radioiodine of the plasma may be inhibited by the initial impact of the therapeutic dose on the tumor, or (2) the released protein-bound I^{131} may be broken down so slowly in the periphery that it is not available for re-utilization by the tumor. Short half-periods were noted in subjects having little evidence of biologic effect on the tumor and also in those with definite tumor damage. This suggests that rapid turnover is a property of the tumor.

There was a rapid fall in the urinary excretion of I^{131} for the first day or two. In some patients this was followed by a secondary rise. Eventually the urinary excretion rate approached that of the rate of disappearance of I^{131} from the body as a whole.

In general, the blood concentration fell rapidly during the first twenty-four hours as the radioiodide was cleared from the blood by the kidneys and the metas-

tases. The concentration then rose to a peak at two to ten days after administration of the dose, subsequently falling on a smooth curve. The secondary rise in blood level results from the iodide released from the thyroid as protein-bound iodide. The gradual fall in concentration represents the slow depletion of I^{131} stored in the thyroid, with consequent decrease in the serum. In this study, however, the blood curves failed to follow the urinary and whole-body curves from the second to the fifteenth days. The half-periods of the blood curves were regularly longer. These deviations from the expected curves may be explained through (1) renal damage during the iodide phase of the blood concentration in the first twenty-four hours, (2) radiation damage to the metastatic lesion which might increase the rate at which protein-bound I^{131} is released, or (3) liberation by the metastasis, as a result of radiation damage, of labeled compounds which are metabolized differently from normal thyroid hormone.

Radiation delivered to the blood during the iodide phase, *i.e.*, before I^{131} is taken up by the tumor, was considerably smaller than that delivered during the protein-bound I^{131} phase. In no case was the irradiation during the initial phase greater then 30.1 rep per 100 mc. of administered I^{131}. In one case irradiation during the iodide phase amounted to only 20.2 rep, but it rose to 212.4 rep during the protein-bound I^{131} phase.

The effects of these large doses on the patients were mild. Three patients experienced mild nausea and vomiting. All had a fall in total white cells, especially lymphocytes. No alarming leukopenias developed, and recovery began in all cases in about one week.

Nine figures; 1 table.

RICHARD F. MCCLURE, M.D.
Palos Verdes Estates, Calif.

Transmission of Radioiodine (I^{131}) to Infants through Human Maternal Milk. Carl E. Nurnberger and Alys Lipscomb. J.A.M.A. **150:** 1398–1400, Dec. 6, 1952.

Two cases are reported of infants breast-fed by mothers who were given diagnostic tracer doses of radioactive I^{131}. Counts over the infant thyroids were made by a shielded end-window type of Geiger-Müller tube at a fixed distance of 7 in. Standardization with wax-sawdust phantoms was used for conversion to microcuries. Radio-assay of the maternal milk was done on copper planchets in comparison to standard solutions.

The first case was that of a 33-year-old Negro woman nursing a 4-month-old boy. Following a 100 μc tracer dose of I^{131}, uptake at twenty-four hours was found to be 34 per cent in the mother's thyroid and 5 per cent in that of the infant. The maternal milk at twenty-four hours showed 0.002 μc per milliliter. At the end of ten days, 15 per cent was present in the maternal thyroid and 2 per cent in the infant's gland.

The second case involved a 22-year-old Negro woman nursing a 4-month-old girl. Twenty-four hours following a 100 μc dose, 18 per cent was found in the mother's gland and 6 per cent in the infant's. Maternal milk showed 0.0013 μc per milliliter. The dose was repeated in two months, following weaning of the baby, with a twenty-four-hour uptake of 36 per cent, a maximal concentration in the maternal milk of 0.039 μc per milliliter at six hours, and a twenty-four-hour milk concentration of 0.009 μc per milliliter. It was felt that if full lactation had been allowed to continue, more radioiodine would have been excreted in the milk.

The authors feel that maternal diagnostic tracer studies may be hazardous to breast-fed infants and that therapeutic doses of radioiodine are contraindicated in such cases because of the possibility of seriously depressing or ablating functional activity of the infant's gland.

Two tables.

WALTER M. WHITEHOUSE, M.D.
University of Michigan

Metabolism of Radiothyroxine in Exophthalmic Goiter. Richard S. Benua, A. Albert, and F. Raymond Keating, Jr. J. Clin. Endocrinol. & Metab. **12:** 1461–1473, November 1952.

Tracer studies with radiothyroxine were performed in 6 patients with exophthalmic goiter. The thyroxine was given intravenously as a single dose. Immediately following its injection and at frequent intervals for the first eight hours, *in vivo* measurements were made at 10 cm. over the liver, left epigastrium, thyroid, and thigh with a Victoreen Geiger-Müller counter and an appropriate scaling circuit. These counts were repeated daily for four to six days. Venous blood was withdrawn at twenty and forty minutes, at one, two, four, eight, and twelve hours, and daily thereafter. Urine was collected at two-hour intervals for the first twelve hours and thereafter at twelve-hour periods for the duration of the experiment. All stools were collected as passed.

There was a rapid fall of the blood I^{131} during the first twelve hours (half-value time, three hours), apparently dependent upon uptake by the thyroid, diffusion into the body fluids, concentration by the liver and gastrointestinal tract, and urinary excretion. The counting rate over the liver was thirteen times that over the thigh, and the rate over the left epigastrium nine times that over the thigh. Urinary excretion was most rapid during the first twelve hours, the curves being similar to the thyroid collection curves.

After the radiothyroxine studies were completed, each of the 6 patients was given a tracer dose of sodium radioiodide. A comparison of the observations showed the proportion of I^{131} collected by the thyroid following the administration of a radiothyroxine tracer to be only about a third of that following the iodide tracer. A similar relationship was noted in the urinary excretion studies. Apparently uptake of I^{131} by the thyroid and its excretion in the urine after administration of radiothyroxine are chiefly dependent upon the rate of release of radioiodine from radiothyroxine.

The main metabolic fate of thyroxine, aside from some excretion in the feces and in the urine, was deiodination. Part of the iodide released was reaccumulated in the thyroid and part was excreted in the urine, depending upon the ratio of thyroid and renal clearances. About a third of the injected hormone was metabolized in twenty-four hours.

Two figures; 6 tables.

RICHARD F. MCCLURE, M.D.
Palos Verdes Estates, Calif.

Studies on Blood-Brain Barrier with Radioactive Phosphorus. II. Hypophysis and Hypothalamus in Man. Louis Bakay. Arch. Neurol. & Psychiat. **68:** 629–640, November 1952.

Continuing his study of the blood-brain barrier with radioactive phosphorus (Arch. Neurol. & Psychiat. **66:**

419, 1951. Abst. in Radiology 59: 632, 1952), the author gave P^{32} intravenously, as a single dose, to 12 human subjects and from six hours to three weeks later studied the component parts of the hypophysis and hypothalamus obtained at autopsy for concentrations of the isotope.

The uptake of P^{32} by the brain from the blood was found to be a very slow process, requiring seven to ten days to reach its maximum. The gray matter of the brain was found to concentrate two to five times as much P^{32} as the white matter. Cerebellar radioactivity was less than that of the cerebral cortex, but more than that of the white matter. Larger deposits of P^{32} were found in the pituitary gland, infundibulum, and tuber cinereum than in other parts of the brain. Other hypothalamic regions did not differ significantly from the central nervous system. The P^{32} concentrated equally in the anterior and posterior lobes of the pituitary, whereas the intermediate lobe contained only 70 per cent of the average amount of the tracer per milligram found in the entire gland. The P^{32} deposit of the infundibulum equaled that of the intermediate lobe of the hypophysis and was less than that in the anterior or posterior lobe. The concentration of the isotope in the adjacent part of the tuber cinereum (the eminentia saccularis) was slightly less than the concentration in the lower parts of the stalk, though still higher than in other parts of the brain. The radioactivity of the supraoptic nucleus was the same as in the adjacent part of the tuber cinereum; the P^{32} content of the optic tract was about 30 per cent less.

The author attributes the high up-take of P^{32} by the pituitary, infundibulum and tuber cinereum to increased permeability of the blood-brain barrier in these areas. The results are similar to those found by other investigators using vital-dye experiments.

Seven figures; 1 table. BERTRAM LEVIN, M.D.
Minneapolis, Minn.

The Use of Phosphorus 32 in Studies on Plasmodium Gallinaceum. I. The Development of a Method for the Quantitative Determination of Parasite Growth and Development in Vitro. II. Studies on Conditions Affecting Parasite Growth in Intact Cells and in Lysates. Delphine H. Clarke. J. Exper. Med. 96: 439–450; 451–463, Nov. 1, 1952.

In the first of these two papers the author describes the development of a quantitative method for determining the extent of the growth *in vitro* of the erythrocytic form of *Plasmodium gallinaceum*. This method utilizes radioactive phosphorus, P^{32}, to measure the extent of the incorporation of phosphorus into nucleic acids, in particular desoxypentose nucleic acids. It was found that the degree of phosphorus incorporation into the DNA fraction could be related to the extent of parasite growth and development observed in stained films.

The second paper is an account of the application of this technic to the study of the effect of various experimental conditions on the growth of the parasite *in vitro*.

Use of I^{131}-Labeled Protein in the Study of Protein Digestion and Absorption in Children With and Without Cystic Fibrosis of the Pancreas. Paul S. Lavik, LeRoy W. Matthews, G. W. Buckaloo, Frances J. Lemm, Samuel Spector, and Hymer L. Friedell. Pediatrics 10: 667–676, December 1952.

Diminished retention of dietary protein in cystic fibrosis of the pancreas has been demonstrated by nitrogen balance studies and stool analyses. The methods, though accurate, are not adaptable to routine performance. There is a need for an accurate and simple method of determining the efficiency of protein digestion and absorption in this condition.

The authors have employed an I^{131}-labeled protein prepared by iodinating calcium caseinate (Casec) after extracting with alcohol and ether to remove lipids. The preparation was administered orally, and fecal specimens were measured for radioactivity.

The patient was prepared by administration of 4 to 10 drops of Lugol's solution every twelve hours during the twenty-four hours preceding and four days following the test meal. (This prevented uptake of isotope by the thyroid.) The test meal, of iodinated calcium caseinate, mixed with non-radioactive calcium caseinate and filler, was administered in place of breakfast. Stool specimens were collected for three days and stored in jars. Urine was collected over the same period and stored in bottles. Blood samples were collected at fifteen, forty-five, ninety, one hundred and eighty and three hundred minutes after ingestion of the meal.

Stool specimens were stirred and placed in a fixed position next to a scintillation counter and the gamma rays were counted. By comparison with a standard solution containing a known amount of I^{131} in a volume equal to that of the fecal sample, it was possible to calculate the total microcuries per specimen. Isotope content of urine and blood samples was expressed as per cent of ingested I^{131}. One microcurie of labeled protein per kilogram of body weight was the dosage used, which is well within safety limits set by the AEC for use in man.

Ten patients with diseases which did not specifically involve the gastrointestinal tract and 5 patients with cystic fibrosis of the pancreas were studied. Among the "controls" fecal excretion did not exceed 6 per cent of the isotope, whereas in children with pancreatic fibrosis, not receiving pancreatin, fecal excretion ranged from 10 to 40 per cent, and averaged 22.5 per cent. When the test meal was administered with pancreatin, fecal excretion of the isotope was decreased about 50 per cent in 2 cases but very little in the other 2. In one of these latter only 8 per cent was excreted when the test was repeated with prehydrolyzed protein. Children with pancreatic fibrosis showed a slower rise in blood radioactivity than the controls and a lower total excretion of isotope in the urine, but the differences were not striking.

The results not only indicate a defect in protein absorption in this particular disease but serve to demonstrate the value of the method in the study of protein digestion and absorption under varying conditions of diet and therapy. The authors suggest a further investigation to evaluate the effectiveness of pancreatin administration.

Preliminary experiments on dogs were conducted to determine the feasibility of using I^{131}-labeled protein, prior to application in the human subjects.

JOHN F. RIESSER, M.D.
Springfield, Ohio

An Automatic Method of Studying the Distribution of Activity in a Source of Ionizing Radiation. W. V. Mayneord and S. P. Newbery. Brit. J. Radiol. 25: 589–596, November 1952.

An interesting method of mechanically scanning a radioactive area and recording the results photo-

graphically is presented. While the details of construction are not given in sufficient detail to encourage copying, the idea is of sufficient potential value to justify mention for those who are working actively with isotopes.

Ten illustrations. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

RADIATION EFFECTS

The Cause, Incidence and Treatment of Irradiation Injuries in the Female Pelvis. Gray H. Twombly, Eduardo Caceres, and James A. Corscaden. Am. J. Roentgenol. **68**: 779–787, November 1952.

This study is based upon the cases of rectovaginal and vesicovaginal fistulas occurring in the Sloane Hospital for Women (New York) from 1917 to 1945 inclusive and the less extensive bladder and rectal complications produced at Memorial Hospital (New York) by four different radiation technics.

In three of the Memorial Hospital series, in which the radium application was kept uniform, bladder injuries varied from 9 to 21 per cent, depending upon the amount of external irradiation reaching the parametria. A higher rate of injury was found in a fourth group of 113 cases (which also showed the highest cure rate) treated by multiple small doses of external roentgen radiation to six pelvic portals, multiple treatments through the vagina in three directions, and a radium tandem for 3,000 mg. hr. In this group there were 10 radiation ulcers of the bladder and 6 cases of hematuria or chronic radiation cystitis. Rectal injuries also varied in proportion to the dose of external roentgen radiation, ranging from 5.5 to 11.8 per cent.

Among 725 cases of cancer of the cervix treated at the Sloane Hospital, there were 10 vesicovaginal fistulas and 3 rectovaginal fistulas which could be attributed to irradiation.

The authors believe that rectovaginal and vesicovaginal fistulas are more frequently due to uncontrolled cancer of the cervix than to irradiation. Those due to the latter cause are attributable to faulty application of the radium or roentgen rays, with either too high a dose in a small area, too high intensity over a short time, or repeated treatment of recurrences in areas which have previously been heavily irradiated.

The management of these complications of irradiation are discussed. The surgical approach for vesicovaginal fistula devised by Twombly and Marshall (Surg., Gynec. & Obst. **83**: 348, 1946. Abst. in Radiology **49**: 130, 1947) is again described. This consists of a plastic procedure utilizing a patch from the posterior vaginal wall plus colpocleisis. Of 15 patients in whom this operation had been done at the time of this report, 10 had complete relief of incontinence with no serious subsequent genitourinary symptoms.

Seven illustrations; 4 tables.

W. L. BRIDGES, M.D.
Indiana University

Radiation Injury of the Kidney. P. W. Davey, J. D. Hamilton, and H. D. Steele. Canad. M. A. J. **67**: 648–650, December 1952.

The authors report the case of a 40-year-old white female who was well until approximately six years before her death, when she first noticed a lump in her right breast. Biopsy was performed, and a pathological report of scirrhous carcinoma was made. A radical mastectomy was done. A total of 11,000 r was administered over the right chest and axilla during a period of five years. The patient remained well for three years and then began to complain of progressively severe backaches, which proved to be associated with metastatic tumor in the lumbar spine. Irradiation was instituted with a total skin dose to the lumbar spine in excess of 11,000 r, given fractionally over a period of four years and eight months. Using isodose curves, it was calculated that a 4,700 r tumor dose would be concomitantly received by the kidneys. The patient gradually deteriorated and died. The kidneys at autopsy showed a lesion consisting of marked tubular degeneration, vascular injury, and interstitial scarring with slight glomerular hyalinization. This was believed due to the chronic radiation injury.

The authors wish to stress that heavy irradiation of the abdomen or spine in the region of the kidneys may do irreparable damage to renal structures and function, even though the kidney is supposedly a radioresistant organ. A detailed description of the microscopic findings is presented.

Six photomicrographs. JOHN M. KOHL, M.D.
Jefferson Hospital

Experimental Radiotherapy of Abdominal Cancer. I. Factors Affecting Radiation Tolerance of the Abdomen in the Rat. Lionel Cohen and Annabelle Cohen. Brit. J. Radiol. **25**: 485–490, September 1952. **II. Effect of a Flavonone (Rutin) on Radiation Reactions.** Annabelle Cohen and Lionel Cohen. Ibid. 601–605, November 1952.

The high incidence and poor prognosis of upper abdominal cancer in man, and particularly of primary carcinoma of the liver in the natives of South Africa, prompted the studies reported here. The experimental observations were made on young albino rats. In order to measure the regional sensitivity of the upper abdomen, it was decided to compare the median lethal doses for total-body irradiation, for homogeneous irradiation of a fixed volume of tissue containing the upper abdominal viscera, and for total-body irradiation with exclusion of the same fixed volume by lead shielding.

From these studies it appeared that the systemic effects of radiation are dependent not only upon the physical integral dose but also upon the anatomical zone treated. The abdominal viscera of the rat, under the conditions of this experiment, showed a degree of radiosensitivity, based on acute systemic effects, in excess of the average value for the whole body by approximately 47 per cent.

Using the rats in the preceding experiment as controls, the authors carried out further studies (reported in Part II) to discover whether it might be possible to raise the tolerance of the host's tissues relative to that of the irradiated tumor by means of some chemical agent. Rutin was selected for this purpose. Administered subcutaneously, it was found to decrease skin reactions and hemorrhagic manifestations, increasing the tolerance of the animals to irradiation of the upper

abdomen by a factor of almost 50 per cent. Delayed damage to the internal organs, however, was not prevented.

Doses of 3 to 9 gm. of rutin were then given to 7 patients receiving irradiation over the liver, pancreas, and stomach. One gram was injected intramuscularly in 5 ml. of normal saline on the two days preceding the initial radiation treatment and immediately before each subsequent treatment. The patients did not suffer from radiation sickness; they showed no evidence of hemorrhagic damage to the intestinal tract, and skin reactions were diminished. There was, however, no indication of any beneficial effect upon leukopenia, anemia, subsequent infection, or late reactions.

Five illustrations; 2 tables.

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Hypothermia and Increased Survival Rate of Infant Mice Irradiated with X-Rays. John B. Storer and Louis H. Hempelmann. Am. J. Physiol. **171**: 341–348, November 1952.

This paper reports the results of an investigation into the mechanism whereby hypothermia increases the survival rate of infant mice given a lethal dose of x-rays. Two hundred sixty adult female mice of the CF_1 strain and 404 infant mice of both sexes eighteen to seventy-two hours old were used in the study. All animals were kept at room temperature (about 25° C.) for the 30-day period after irradiation. The adult animals were divided at random into five groups. In the experiments with infant mice, the litters were divided equally among the experimental groups, and the extra mice of each litter were allowed to remain with the mother.

The animals were chilled by being placed in a refrigerator set at the desired temperature. Radiation factors were 250 kv.p., 15 ma., an inherent tube filtration equivalent to 2 mm. of Al with added 0.25 mm. Cu and 1.0 mm. Al filters, and an intensity rate of about 100 r per minute. The target-to-animal distance was 40 cm.

It was found that the survival of infant mice irradiated while in a state of extreme hypothermia (about 5°C.) was almost twice that of litter mates exposed to the same doses of total-body x-rays at room temperature. The mortality rate was not affected in infant animals less severely chilled nor in the adult mice, which were anesthetized before chilling. The protection afforded by extreme chilling was of about the same degree as that produced by placing the animals in a nitrogen atmosphere; furthermore combining anoxia with refrigeration did not enhance the radiation protection. The benefit derived from extreme chilling was less if animals were placed in pure oxygen rather than in nitrogen. It is concluded that lowered tissue oxygen played an important, if not a crucial, role in increasing the survival rate of chilled infant mice.

Five tables.

Survival of Irradiated Rats During Prolonged Exposure to Environmental Cold. D. J. Kimeldorf and B. D. Newsom. Am. J. Physiol. **171**: 349–353, November 1952.

The investigation described here was undertaken to provide additional information concerning the influence of prolonged exposure to low environmental temperature upon radiation injury in adult mammals following a wide range of x-ray doses.

Sprague-Dawley rats were used throughout the study. Control and irradiated animals were selected from litters born the same week and were of similar weight. Animals were confined to individual cages, one set of cages being used in the cold chamber while a second set of cages was used to maintain control animals in an air-conditioned animal colony room. The mean temperature for the colony room was 23° ± 2° C. during the course of the study. All animals were maintained at 23° C. in the temperature exposure cages for at least one week prior to experimentation; those animals not having regular weight increments during this acclimatization period were discarded.

All animals were irradiated at an ambient temperature of 23°. Radiation factors were 250 kv.p., filtration of 0.5 mm. Cu plus 1 mm. Al (half-value layer 1.5 mm. Cu); target-subject distance, 40 inches; dose rate, 25 r per minute (air dose) measured with Victoreen thimble chambers. Total-body exposures to doses in the range of 400 to 900 r were made. All dose measurements were accurate within ±5 per cent.

Prolonged exposure to a lowered environmental temperature (6° C.) was found to increase the mortality rate following lethal doses of x-rays. The mean survival time for animals dying during the thirty-day post-irradiation period was shortened by prolonged exposure to a cold environment. Irradiated animals died at an environmental temperature (6° C.) well tolerated by normal animals, although the dose of radiation was sublethal for animals maintained at normal room temperature (23° C.). The mechanism for the observed alterations in mortality of irradiated rats following exposure to cold is not known, although available evidence suggests that increased metabolic activity may be an important factor.

Two tables.

Effect of X-Irradiation on Connective Tissue Ground Substance in Mice. Robert H. Edgerley. Am. J. Physiol. **171**: 668–677, December 1952.

The author describes a new method for the study of the rate of absorption of subcutaneously injected solutions in mice, which has been applied to the problem of how x-rays influence such absorption. The following observations were made: (1) Total-body x-irradiation decreases the size of the connective-tissue bullae produced by subcutaneously injected 0.3 molal sucrose as measured two hours after injection. (2) Irradiation twenty-four hours before or just before injection has a greater effect than when applied after injection. (3) Irradiation administered approximately twenty-four hours before injection has less effect than when applied just before. (4) Of the doses tested and administered before injection of the sucrose solution, 500 r exerted a maximal effect. The effects of the larger doses employed were not significantly different from those produced by 500 r. (6) There is no significant effect on the water content (or uptake) of the skin as measured approximately two hours after irradiation, but about twenty-four hours after irradiation the water content was reduced. (7) Whereas the average water contents (or uptakes) of the skins were very different in the two experiments performed, i.e., in males and females, this had no effect on the size of the bullae in either the control or irradiated mice.

These results are interpreted as evidence that x-rays interfere with the formation or the maintenance of the connective-tissue ground substance barrier to absorption. Regardless of how such interference is produced, it may be postulated that this effect plays an important role in the effect of x-rays on the immune reactions to infection.

One photograph; 1 graph; 2 tables.

Anomalies Occurring in Children Exposed in Utero to the Atomic Bomb in Hiroshima. George Plummer. Pediatrics **10**: 687–693, December 1952.

A study was made, in the summer and autumn of 1950, of 205 children born between Jan. 1, and May 1, 1946, whose mothers had been within the city limits of Hiroshima at the time of the atomic explosion of Aug. 6, 1945. The children had survived to the age of approximately four and a half years. They had been in the first trimester of intra-uterine life at the time of the explosion.

A history was obtained from each mother by a Japanese physician, including an account of injuries, burns, and symptoms following the blast which suggested radiation sickness (epilation, purpura, fever, vomiting, diarrhéa, gingival bleeding, and oropharyngeal lesions). Location of the mother as to distance from the hypocenter of the blast was ascertained, along with information concerning previous pregnancies and the course and termination of the pregnancy under study.

The infants were given complete physical examination by an American pediatrician, and height, weight, and head circumference were determined. A complete history of growth and development was obtained and estimation of mental development was made by a Japanese physician.

Eleven of the group were exposed within 1,200 meters of the bomb hypocenter; the remainder were beyond this distance. Seven of the 11 children had microcephaly with mental retardation, while none of the 194 exposed at greater distances presented this finding. Other congenital anomalies were discovered in the total group, but only microcephaly with mental retardation occurred more frequently than in the general Japanese population. There was no correlation demonstrable between any of the anomalies and such factors as mother's age, birth order, or week of gestation at the time of bombing.

Of the 4 children exposed within 1,200 meters who did not show microcephaly with mental retardation, one had small head measurements but a normal mental development. The other 3 had normal head circumferences. The mothers of these 3, while within 1,200 meters, had some shielding from buildings. One mother was in the sixth week of gestation, the earliest in this group, at the time of exposure, and it is suggested that there may be a critical period of gestation before which nervous system defects may not be produced.

The method of study as outlined obviously leaves gaps in a complete evaluation of the effect of irradiation on pregnancy. Abortions, stillbirths, and neonatal and infantile deaths were necessarily omitted, and the probability is great that some heavily irradiated fetuses were so severely damaged *in utero* that death occurred before term or in early postnatal life. Fetuses in the latter part of intrauterine life were also not included.

Three tables.

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